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Trends in Engineering Education

1949 to 1959

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Highlights

From 1949 to 1959 there were net increases in the total number of engineering curriculums offered, both those recognized by the Engineers' Council for Professional Development and those not so recognized, with a smaller percentage of discontinuation among the recognized curriculums than among the others.

◆ ◆ ◆

The number of engineering bachelor's degrees declined 13 percent between 1949 and 1959, as compared to an increase of 5 percent in all bachelor's degrees in all fields, including engineering. At the graduate level, engineering degrees increased by 56 percent, compared to an increase of 41 percent in graduate degrees in all fields, including engineering.

◆ ◆ ◆

Comparisons of the rate of growth in different curricular fields are presented based on (a) numbers of curriculums, (b) numbers of undergraduate degrees, or (c) numbers of graduate degrees. These are then combined into one overall rating, under which the fields which have enjoyed the greater percentage of growth are in *new* fields of engineering, followed closely by the more *scientific* branches of engineering.

◆ ◆ ◆

Revisions of curriculums have taken place at a more rapid rate since the publication of the American Society for Engineering Education *Report on Evaluation of Engineering Education* than before it, and changes definitely planned for the near future will be at a still faster rate. Both the amount and the nature of changes are chiefly in the direction of meeting the recommendations of the ASEE report.

◆ ◆ ◆

The numbers of "three-two" programs and of 5-year undergraduate engineering curriculums in operation have increased throughout the period covered by this study, but at a slower rate since the publication of the ASEE report mentioned above than before it, and the number announced as definitely planned for the near future shows a still slower rate of increase.

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Trends in Engineering Education
1949 to 1959

By HENRY H. ARMSBY, *Chief for Engineering Education*
Division of Higher Education

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
ABRAHAM A. RIBICOFF
Secretary

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Contents

Page

Foreword VII

Introduction 1

Origins of This Study 1
Previous Pertinent Studies 2
Organization of This Report 3
Regional Grouping of Institutions 4
Definitions and Abbreviations 4

I. Institutions Participating in Study 7

Distribution of Responding Institutions 7
Respondents, by Enrollments 8
Additional Follow-up on Special Programs 9

II. Trends in Curriculums Offered 10

"Old" Curriculums Offered 10
"New" Curriculums Offered 11
Number of Differently Named Curricular Fields 12
Trend Toward Greater Emphasis on Graduate Education 14

III. Trends in Degrees Conferred 15

Degrees Conferred in "Old" Curriculums 15
Degrees Conferred in "New" Curriculums 16
Degrees Conferred During Academic Year 1959 17
Degrees Conferred in Different Curricular Fields 18

IV. Fields of Most Rapid Growth 20

Data Available for Study of Comparative Growth 20
Numbers of Curriculums 20
Bachelor's Degrees Conferred 21
Graduate Degrees Conferred 22
Fields Established Since June 1949 23
Fields of Most Rapid Growth 23

V. Trends in Curriculum Revisions 25

Report on Evaluation of Engineering Education 25
Changes Reported by Respondents 25
Changes Before and After the ASEE Report 26
Direction of Changes 27
Amount of Change 27
Summary 28

Page
Development of Special Programs 30
The "Three-two" Program 30
The 5-Year Undergraduate Engineering Curriculum 33
General Comments by Engineering Deans 36
Appendix I.—Basic Tables 39
Appendix II.—Questionnaire Form 61

Text Tables

A. Responding institutions: Number in survey and number and percent of respondents; by type of control, by region 7
B. Responding institutions: Number and percent of institutions and of engineering enrollments, fall 1958, represented in replies to questionnaire; by region 8
C. "Old" curriculums: Status during academic year 1959 of curriculums and options offered during academic year 1949; by ECPD-recognized and "other," by region 11
D. "New" curriculums: Status during academic year 1959 of curriculums and options established since June 1949; by ECPD-recognized and "other," by region 12
E. Differently named curricular fields: Number and percent in academic years 1949 and 1959; by ECPD-recognized and "other" 13
F. "Old" curriculums: Number of degrees conferred in academic years 1949 and 1959 in curriculums and options which were offered in academic year 1949; by ECPD-recognized and "other," by level, by region 16
G. "New" curriculums: Degrees conferred in first year degrees were granted and in academic year 1959 in curriculums and options established since June 1949; by ECPD-recognized and "other," by level, by region 17
H. "Old" and "new" curriculums: Number of curriculums offered and degrees conferred in academic year 1959 in "old" and "new" curriculums and options; by level, by region 17
I. Differently named curricular fields: Number and percent of curriculums offered and degrees conferred in academic years 1949 and 1959; by ECPD-recognized and "other" 19
J. Fields of most rapid growth: Rank order of "expansion ratios" for curriculums which have ratios larger than the national average under *all three* of the categories shown, and the average of the three rank orders for each curriculum 24
K. Time distribution in scientifically oriented curriculums, as recommended by the Committee on the Evaluation of Engineering Education of the American Society for Engineering Education 25
L. Curriculum changes: Number of institutions which made or plan changes in the percentages of time assigned to various blocks of courses; by academic year, by region 26

Page

M. Curriculum changes: Number of institutions which made or plan changes in the percentages of time assigned to various blocks of courses and the direction of the change, by region and by blocks of courses ---- 27

N. Curriculum changes: Percentage of time devoted to various blocks of courses in 1949, 1955, and 1959, and planned for 1961; by region; and the number of reports received ---- 29

O. "Three-two" programs: Number of engineering colleges which established or plan "three-two" programs, by academic year; and number which discontinued such programs; by region ---- 32

P. "Three-two" programs: Number of "three-two" programs in operation during academic year 1959; engineering colleges involved; "three-two" students enrolled in engineering colleges; and students who have received the two degrees; by region ---- 33

Q. Five-year undergraduate engineering curriculums: Number established; by academic year, by region ---- 34

R. Five-year undergraduate engineering curriculums: Number offered in academic year 1959; by curriculum, by region ---- 35

Basic Tables

1. "Old" curriculums: Number of curriculums and options offered during academic year 1949 in various categories; by curriculum, by ECPD-recognized and "other"; by region ---- 40

2. "New" curriculums: Number of curriculums and options established since June 1949 in various categories; by curriculum, by ECPD-recognized and "other"; by region ---- 44

3. "Old" curriculums: Number of degrees granted during academic years 1949 and 1959 in curriculums and options offered in academic year 1949; by curriculum, by ECPD-recognized and "other," by region ---- 48

4. "New" curriculums: Degrees conferred in first year degrees were granted and in academic year 1959 in curriculums and options established since June 1949; by curriculum, by ECPD-recognized and "other," by region ---- 52

5. "Old" and "new" curriculums: Number of curriculums offered and degrees conferred in academic year 1959; by curriculum, by ECPD-recognized and "other" ---- 56

6. Differently named curricular fields: Number of curriculums offered and degrees conferred in academic years 1949 and 1959; by curriculum, by ECPD-recognized, by "other" named in academic year 1949, and by "other" named since June 1949 ---- 59

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Foreword

ENGINEERING EDUCATION has long been a live and active field, one in which much experimental work has been done, and one which has been subject to a continuous process of careful and painstaking examination on the part of the engineering colleges.

Much of this study and examination has been done under the auspices of committees of the American Society for Engineering Education. The author of this bulletin has been a vice president of this Society, has served on its National Council for many years, and has been a member of several of the committees mentioned above. These experiences, especially as a member of the Committee on Evaluation of Engineering Education in 1952 to 1955, were major factors leading him to make his study of "other" engineering degrees and enrollments in 1958.

This study gave some indication as to changes in the types of engineering curriculums being offered in American colleges and universities and pointed up the need for fuller information. The changes reflect, at least in part, the response of the engineering colleges to the changing patterns of life stemming from experiences during World War II, and from the rapidly expanding applications of scientific developments to industry and the life of the Nation. The U.S. Office of Education believes that these changes in engineering education have important implications for all fields of education, and that a study of them is a worthwhile activity for the Office. This belief led to the author of this bulletin to the design and execution of the study herein presented.

There are three types of programs in use by engineering colleges in addition to the "standard" 4-year engineering curriculum which is in effect in the great majority of institutions. These are the 5-year undergraduate engineering program, the "three-two" program, and the cooperative engineering education programs. The recent publication in the *College Blue Book* of the complete roster of institutions conducting cooperative programs (in the preparation of which the author of this bulletin collaborated) gives particular timeliness to the development of a complete tabulation of the number of institutions, both engineering and nonengineering, which are cooperating in the conduct of the "three-two" program, and of institutions conducting 5-year undergraduate engineering programs. Such tabulations are included in this bulletin, and a complete roster of institutions offering the "three-two" plan will appear in a forthcoming bulletin by the same author.

The facts presented in this study and the trends which they exemplify should furnish to college teachers and administrative officers a picture of how one field of education has attempted to modify its procedures and adapt its programs to changing national developments. It is hoped that this bulletin will have value to educators not only in the engineering colleges but in any other field of education which is concerned with similar modifications and adaptations.

HOMER D. BABBIDGE, JR.
Assistant Commissioner
for Higher Education

Introduction

ENGINEERING EDUCATION, like any field of education, if it is to be successful must be constantly alert to the needs of its students and to the services which its graduates will render to society. In addition, professional education must be concerned with the needs of the particular segment of society served by that profession. The first of these objectives means that engineering education must give its students a good liberal education to prepare them for their duties as citizens of a democracy. The second means that it must also give them a broad training in the fundamental sciences, particularly the physical sciences, and in the practical application of these sciences to the design, construction, operation, and maintenance of machines and structures to advance our economic, industrial, and military growth and development, and for the general improvement of national and international standards of living.

Mindful of these responsibilities, engineering education has long been a live and active field in which much experimental work has been done, and one which has been under continuous careful and painstaking study by those responsible for the conduct of engineering colleges. They have sought to maintain a close and intimate contact with industry on the one hand, and with basic science on the other, at the same time strengthening their programs of general education. The steady growth of industry and of scientific knowledge, and the growing use of science in industry, have resulted in a practically continuous program of revisions of educational offerings in the engineering colleges.

This program of revisions has been particularly active since World War II, because of the constantly accelerating growth of scientific knowledge and of its industrial applications. This has resulted in many new curriculums being offered, in many changes in the basic science and humanistic content of engineering curriculums, and in the expansion of special types of programs, such as the cooperative engineering education program and the "three-two" program.

This bulletin attempts to sum up the more important changes in engineering education which have taken place during the last 10 years, and in some cases to look ahead for about the next 2 years. This 12-year period is long enough to have some historical value, but recent enough to avoid at least the more serious of the unsettled conditions which immediately followed World War II.

This bulletin is largely a factual one, although it lays no claim to any high degree of mathematical accuracy. It rather attempts to present such facts as will point up the general trends in the national program of engineering education.

Origins of This Study

The author of this bulletin was privileged to serve as a member of the Committee on Evaluation of Engineering Education of the American Society for Engineering Education (ASEE) during the years 1952 to 1955. The final report of this committee, published in 1955, is generally considered one of the milestones in engineering education. It called for some rather fundamental changes in the organization of engineering curriculums. Notably, it recommended an increase in the proportion of time to be devoted to "humanistic-social" courses and to basic science courses and engineering science courses, with a corresponding decrease in the proportion of time devoted to strictly engineering technology courses. The "followup" study in 1959 by Dean L. E. Grinter, of the University of Florida, who had served as chairman of the Committee on Evaluation, gave an indication of changes within established curriculums which had followed the consideration by the institutions of the recommendations of the committee.

In July 1958, the writer of this bulletin made a study which was published in the *Journal of Engineering Education* of ASEE in the issue of February 1, 1959, under the title *An Analysis of "Other" Engineering Curricula.* It consisted of an anlysis of the enrollments and degrees included in the U.S. Office of Education (USOE) Circular No. 516, *Engineering Enrollments and Degrees, 1957*, under the heading "Other." These are the enrollments and degrees which are reported to the Office by the institutions as being in curriculums other than those accredited in at least one institution by Engineers' Council for Professional Development (ECPD). This procedure has been followed every year since 1949 in the jointly prepared reports published separately by the Office and the Society, which contain tabulations of a different form which supplement each other without duplication.

Considerable interest as to just what curriculums were included in the category "other" prompted the analysis and the publication referred to above. Distribution of the "other" enrollments and degrees was made almost entirely from notes on the institutional reports.

The study developed a list of 32 different curriculums not recognized by accreditation by ECPD, and there were still some enrollments and degrees unaccounted for.

This tabulation of "other" engineering curriculums gave some indication as to changes in recent years in the types of engineering curriculums offered in American colleges and universities. Many of them were believed to have been established quite recently, and to reflect the response of the engineering colleges to such recent developments as the industrial and military uses of nuclear energy, electronic controls and computers, the rapidly expanding use of plastics, and the extension of automation. Others reflected the growing importance of interdisciplinary studies (e.g., biochemistry, biophysics, etc.).

The combination of events mentioned above led the writer to believe that there would be some value to engineering educators in the results of a study designed to collect additional information as to new or modified curriculums during the last few years. The basic idea of this study received rather general approval among engineering deans, and a detailed questionnaire was developed and submitted to a small group of deans for careful appraisal and criticism. As a result of their suggestions the original questionnaire was simplified, approved by the Bureau of the Budget, and printed. A copy of the questionnaire is included in this bulletin as appendix II.

Previous Pertinent Studies

Some of the outstanding studies in the field of engineering education, all sponsored by ASEE, and all having a bearing on this study, are:

1. *The Report of the Investigation of Engineering Education, 1923-29*—often called the "Wickenden Report" because the director of investigations for the ASEE Board of Investigation and Coordination was former President W. E. Wickenden of Case Institute of Technology—was published by the Society in two volumes in 1930 and 1934. The Board enlisted the aid of several general committees of the Society, of institutional committees in 150 cooperating colleges, and of a number of leading national engineering societies and other organizations. Facts and opinions were collected from more than 20,000 college students, alumni, teachers, and practicing engineers.

The report covered a thoroughgoing study and analysis of engineering education, dealing with such major subjects as personnel (students, graduates, and teachers), curriculums and methods of instruction, supplementary services of the engineering colleges and the costs of engineering education, the relationship of engineering education to the professions and to American industry, and engineering education in Europe. It is a monumental report which has been a model both as to organization and procedures for many later reports, not only in engineering but also in other fields.

2. *The Report of the Committee on Aims and Scope of Engineering Curricula*—often called the "Hammond Report" because the committee which prepared it was headed by former Dean H. P. Hammond, of the Pennsylvania State University—was published in the March 1940 issue of the *Journal of Engineering Education* of ASEE. It arose out of the discussions at the time of the desirability of lengthening the undergraduate

engineering curriculum to 5 or 6 years, and of a preliminary period of study in schools of liberal arts before admission to the engineering school. The committee concerned itself with current problems in engineering and in engineering education, the controlling factors under which engineering educational programs were being conducted, and general policies recommended for the engineering colleges with respect to the scientific-technological studies and the humanistic-social studies which should accompany them.

3. *The Report of the ASEE Committee on Engineering Education After the War* was also prepared by a committee headed by former Dean Hammond and is frequently called the "Second Hammond Report." It was published in the *Journal of Engineering Education* of ASEE in May 1944. It reaffirmed the two major divisions of engineering education recommended in the earlier report, and discussed the means of achieving the purposes of the curriculum, the objectives and methods of organization and instruction for the humanistic-social stem and for the scientific technological stem, instruction in the engineering method, discipline in engineering habits of work, measurement of achievement, recruitment and development of faculties, the cultivation of creative ability, the proper place of instruction and research as complementary phases of the work of engineering colleges, graduate work, and subprofessional technological education and training.

The committee also discussed the preparation for engineering in secondary schools and in junior colleges, selectivity in the admission of students, scholastic ability versus financial resources, physical conditioning of students, intensive programs such as ESMWT, education of veterans and of war industry workers, the accelerated program, academic credit for military programs, and the rehabilitation of faculties.

4. *The Report of the Committee on Improvement of Engineering Teaching*, prepared by a committee headed by Dean L. E. Grinter, of the University of Florida, was published in the *Journal of Engineering Education* of ASEE in September 1952. This report was the responsibility of a committee of 39 members of ASEE, aided by important and closely coordinated work by institutional committees in over 100 colleges and universities. The committee concerned themselves with the objectives of engineering education, the principles of teaching and learning, the development of resourcefulness and originality, coordination of instruction both within the engineering courses and with the humanistic-social courses, and the development and growth of teachers.

5. *The Report of the Committee on Evaluation of Engineering Education*, also prepared by a committee headed by Dean Grinter, was published in the *Journal of Engineering Education* of ASEE in June 1955. The committee of 46 members of the Society was aided by institutional committees in 122 institutions. The report covers such subjects as the objectives of engineering education and their implementation, the selection and development of an engineering faculty, curricular content as related to the objectives in engineering education, and curricular areas and content. These areas are subdivided into the basic sciences, the engineering sciences, engineering analysis and design, humanistic and social studies, and electives. The committee included a summary of time distribution for a "scientifically oriented engineering curriculum," which it considered would be necessary for the development of engineers able to "face new and difficult engineering situations with imagination and competence."

6. *A Survey of Current Changes that are Modernizing Engineering Education*, Dean Grinter's review of developments since the appearance of the report on evaluation of engineering education, was published in the March 1959 issue of the *Journal of Engineering Education* of ASEE. It presented statistical data and discussions on engineering faculty changes, changes in science content of engineering curriculums, and engineering curricular changes other than in science, all covering approximately the period 1954–58.

Organization of This Report

This report is organized into an introduction, seven major sections, and two appendixes, as indicated in the table of contents. The first major section presents data concerning the numbers, geographic distribution, and type of control of the institutions to which questionnaires were sent, and of those institutions (hereafter called respondents) which returned usable replies (text tables A and B).

The second major section shows the trends which have been occurring in the number and types of engineering curriculums offered by the "respondents." Data supplied by the institutions have been combined into basic tables 1, 2, and 6 (in app. I), which are summarized in text tables C, D, and E.

The third major section sets forth the trends in engineering degrees (both undergraduate and graduate) conferred by respondents. Data from the institutions are set forth in basic tables 3, 4, 5, and 6 (in app. I), and summarized in text tables F, G, H, and I. The concept of the "expansion ratio" used in the fourth major section is developed in text table I.

The fourth major section seeks to identify the curricular fields of engineering education which have enjoyed the most rapid growth. Expansion ratios are compared under three criteria: (1) Number of curriculums, (2) number of bachelor's degrees, and (3) number of graduate degrees. In text table J are listed and ranked those curricular fields with "expansion ratios" higher than the national average in *all three* of the categories listed above.

The fifth major section presents data supplied by respondents concerning general trends in curriculum content in the five major blocks of courses contained in the ASEE Report on Evaluation of Engineering Education (listed in text table K). The number (by year), direction, and size of curriculum changes are set forth in text tables L, M, and N, respectively.

The sixth major section is devoted to a study of the development of two special types of programs, the so-called three-two program (text tables O and P), and the 5-year undergraduate engineering curriculum (text tables Q and R). Both programs have been in existence in a few institutions for a good many years, but have developed quite rapidly in recent years.

The seventh major section consists of abstracts of some of the statements made by deans of engineering in response to a request for general comments which constituted the last item on the questionnaire (app. II).

Regional Grouping of Institutions

For the purposes of this study the engineering colleges of the country have been grouped into seven geographic regions. The first six of these constitute the regional classification employed by the Engineering Manpower Commission of Engineers Joint Council in its *Survey of Engineering Educational Facilities* published in 1957. The same classification was used in the report *Engineering Enrollment and Faculty Requirements, 1957–67*, submitted by the Committee on Development of Engineering Faculties of the American Society for Engineering Education in 1958, and in one or two supplementary reports. The seventh region consists of Alaska, Hawaii, and Puerto Rico, which were not included in either of the studies mentioned above.

This regional organization is used to enable persons interested to make comparisons between the data reported herein and the data contained in the two reports named above.

The seven regions are:

I. East
Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont.

II. South
Alabama, Delaware, District of Columbia, Florida, Georgia, Kentucky, Maryland, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, West Virginia.

III. South Central
Arkansas, Louisiana, Oklahoma, Texas.

IV. Midwest
Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin.

V. Mountain
Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming.

VI. Pacific
California, Oregon, Washington.

VII. Outlying
Alaska, Hawaii, Puerto Rico.

Definitions and Abbreviations

The following definitions and abbreviations will be used in this report in order to save space:

Academic year.—A period of a year ending with June 30 of the year named. For example, academic year 1949 means the year ending June 30, 1949. This will be abbreviated as AY 1949.

ASEE.—The American Society for Engineering Education.

Blocks of courses.—In the section of this bulletin dealing with *Trends in Curriculum Revision* frequent reference will be made to five blocks of courses. These are the blocks outlined in the *Report on Evaluation of Engineering Education* by the Committee of the same name of the American Society for Engineering Education to the Society in 1955, which was published in the *Journal of Engineering Education*, issue of September 1955. These blocks are:

1. Humanistic and social studies.
2. Mathematics and basic sciences.
3. Engineering sciences.
4. Sequence of engineering analysis, design, and engineering systems, including the necessary technological background.
5. Options or electives in (*a*) humanistic and social studies, (*b*) basic science, (*c*) engineering science, (*d*) research or thesis, (*e*) engineering analysis and design, (*f*) management.

ECPD.—The Engineers' Council for Professional Development, a federation of eight major national engineering societies, the objectives of which are, among others, to accredit curriculums of engineering colleges, to promote the educational and professional development of young engineers, and to advance the standards and status of the profession. ECPD is the nationally recognized body for the accreditation of engineering curriculums.

ECPD-recognized.—This expression will be used to designate any curriculum which ECPD has accredited in at least one institution. In a particular institution this curriculum may or may not be accredited. The list used in this publication is the list published following the 1957 meeting of the Engineers' Council for Professional Development. This was published early in 1958 and was the list in effect at the time the questionnaires for this circular were sent to the institutions. The curriculums contained in this list are:

Aeronautical Engineering
Agricultural Engineering
Architectural Engineering
Ceramic Engineering
Chemical Engineering
Civil Engineering
Electrical Engineering
Engineering Mechanics
Engineering Physics
General Engineering
Geological Engineering
Geophysical Engineering
Industrial Engineering
Mechanical Engineering
Metallurgical Engineering
Mining Engineering
Naval Architecture and Marine Engineering
Petroleum Engineering
Sanitary Engineering
Textile Engineering

Actions of the ECPD Committee on Education and Accreditation at its meetings in 1958 and 1959 added five new curriculums to the list of those recognized by accreditation in at least one institution. These additions are:

Building and Construction Engineering
Engineering Science
Nuclear Engineering
Transportation Engineering
Welding Engineering

In this study these curriculums are included among the "other" curriculums because at the time the questionnaire was sent out they had not been accredited anywhere by ECPD. They therefore were not listed on the blanks sent to the institutions in the annual enrollment and degree surveys, and therefore the institutions had no opportunity to report enrollments or degrees in these curriculums except by including them in "other."

Expansion Ratio.—The ratio for a curriculum or group of curriculums of the number of such curriculums offered in AY 1959 to the number offered in AY 1949. Also used to indicate the corresponding ratio for number of degrees conferred.

"Other" curriculums.—This term will be used to designate all curriculums except those which are "ECPD-recognized."

"Old" curriculums.—Curriculums which were in operation during academic year 1949, regardless of whether or not they still are in operation, and regardless of accreditation status then or later.

"New" curriculums.—Curriculums established in individual institutions since June 30, 1949. Many of these are in the same fields as "old" curriculums in other institutions, but for the particular institution concerned the curriculum is a "new" one. Thus a given curriculum, for example, civil engineering, may be an "old" curriculum in one institution and a "new" curriculum in another.

Respondent.—An institution which returned a completed questionnaire in usable form within the time limit set for the study.

States.—For the purposes of this circular the District of Columbia and Puerto Rico are considered States, making a total of 52 "States" from which data were collected.

USOE.—The United States Office of Education.

I. Institutions Participating in Study

AN ANALYSIS of the institutions which returned usable questionnaires indicates that while complete coverage of the engineering schools was not attained the responding institutions constitute a satisfactory sample of the engineering colleges of the country. As has been previously indicated, it was not the intention in the major part of this study to attain a high degree of mathematical accuracy of data presented. Rather, it was desired to collect and present sufficient data to indicate general trends in the programs of engineering education of the country. It is believed that this objective has been attained.

A tabulation of the questionnaires mailed out and of usable questionnaires returned within the time limit set for the study is shown in text tables A and B.

Questionnaires were mailed on October 23, 1959, to the 226 institutions which had reported either engineering enrollments or degrees or both in the study of engineering enrollments and degrees conducted jointly by the Office of Education and the American Society for Engineering Education during the fall of 1958. These are reported in Office of Education Circular No. 555, *Engineering Enrollments and Degrees, 1958.* This circular contained the latest information then available on engineering enrollments and degrees.

Up to December 8, 1959, usable replies had been received from 106 of these institutions. A followup was sent on that date to the remaining 120 institutions. Up to January 19, 1960, a total of 175 usable replies had been received. This study is based on these 175 institutions. Certain basic facts about these institutions are contained in tables A and B.

Distribution of Responding Institutions

Responding institutions are situated in 48 of the 52 States (considering for the purposes of this discussion that the District of Columbia and Puerto Rico are States). All States in regions I, II, and III are represented, and all but one in each of the other regions, a total of 48 out of 52 States, or 92 percent of the entire number.

Table A.—Responding institutions: Number in survey and number and percent of respondents; by type of control, by region

Region	All institutions			Public			Private		
	Number	Responding		Number	Responding		Number	Responding	
		Number	Percent		Number	Percent		Number	Percent
1	2	3	4	5	6	7	8	9	10
United States total	**226**	**175**	**77**	**120**	**95**	**79**	**106**	**80**	**75**
I. East	67	53	79	20	16	75	47	37	79
II. South	40	32	80	27	23	85	13	9	69
III. South Central	20	15	75	13	10	77	7	5	71
IV. Midwest	53	42	79	28	23	82	25	19	76
V. Mountain	18	11	61	15	10	67	3	1	33
VI. Pacific	25	20	80	14	11	79	11	9	82
VII. Outlying	3	2	67	3	2	67	0	0	--------

The distributions in columns 2, 3, and 4 show the number of institutions in each region to which questionnaires were sent, and the number and percentage in each region and in the Nation from which usable replies were received. Of the 226 institutions receiving questionnaires, 175, or 77 percent, responded.

The data as to type of control (cols. 5 to 10) are inserted merely as a check on the reliability of the "sample" of institutions represented by the 175 respondents. These data will not be used in subsequent analyses because of the small number of institutions in some of the "cells."

These data show the number of institutions in each region and in the Nation which are publicly supported, the number and percentage of such institutions in each region and in the Nation from which usable replies were received, and similar data for the privately supported institutions.

Usable replies were received from 95 publicly supported institutions, or 79 percent of the 120 such institutions to which questionnaires were sent, and from 80 privately supported institutions, or 75 percent of the 106 such institutions queried.

Usable replies therefore were received from 92 percent of the "States," from 77 percent of the total number of institutions queried, from 79 percent of the publicly supported institutions, and from 75 percent of those privately supported. The variations among the regions are not extreme, and the respondents therefore constitute a reasonably valid "sample" of the Nation's engineering colleges, with a good geographic distribution and with no particular bias toward either publicly supported or privately supported institutions.

Respondents, by Enrollments

In table B is shown an analysis of the responding institutions based on the engineering enrollments at undergraduate and graduate levels. These enrollments were reported by the institutions in the fall of 1958, and published in Office of Education Circular No. 555, *Engineering Enrollments and Degrees, 1958*. It will be noted that columns 1, 2, 3, and 4 of table B are the same as columns 1, 2, 3, and 4, respectively, of table A. They are repeated here simply for easy reference.

The small number of institutions in region VII and the fact that the largest institution in the region did not respond seem to indicate that the data reported for this region in subsequent sections of this study may not be as representative of conditions in the region as are the data for the other six regions. They are, however, reported in order to complete the tables, and because they are included in national totals.

The undergraduate enrollments reported by the institutions in each of the regions totaled 256,779 for the Nation (col. 5). The undergraduate enrollment in those institutions in each region from which usable replies were received, totaled 216,131 for the Nation (col. 6). These enrollments are

Table B.—Responding institutions: Number and percent of institutions and of engineering enrollments, fall 1958, represented in replies to questionnaire; by region

Region	Institutions			Engineering enrollment, fall of 1958					
				Undergraduate			Graduate		
	Total	Responding		Total	Responding		Total	Responding	
		Number	Percent		Number	Percent		Number	Percent
1	2	3	4	5	6	7	8	9	10
United States total	**226**	**175**	**77**	**256, 779**	**216, 131**	**84**	**32, 901**	**28, 148**	**86**
I. East	67	53	79	64, 773	56, 714	88	14, 122	12, 306	87
II. South	40	32	80	41, 440	37, 111	90	2, 997	2, 821	94
III. South Central	20	15	75	24, 892	18, 290	73	2, 027	1, 782	88
IV. Midwest	53	42	79	87, 014	76, 136	87	7, 844	6, 944	89
V. Mountain	18	11	61	17, 491	12, 273	70	1, 690	1, 273	75
VI. Pacific	25	20	80	18, 653	14, 609	78	4, 221	3, 022	72
VII. Outlying	3	2	67	2, 516	998	40	0	0	--------

expressed as percentages of the total undergraduate enrollment for the region and for the Nation in column 7. The enrollments in responding institutions constituted 84 percent of the total enrollments in the Nation, with variations among regions (except for region VII), varying from 70 to 90 percent.

The total graduate enrollment in the engineering colleges in each region and in the Nation totaled 32,901 for the Nation (col. 8). The graduate enrollments in the responding institutions totaled 28,148 for the Nation (col. 9). These enrollments are expressed as percentages of the total graduate enrollment in each region and in the Nation in column 10. The national percentage is 86 percent, with a range in the various regions from 72 to 94 percent.

Thus, the 77 percent of the engineering colleges which submitted usable replies to the questionnaire enrolled 84 percent of the undergraduate students in the country and 85 percent of the graduate students. This indicates a small weighting of the sample toward the larger institutions as compared to the smaller ones.

Table B also shows a slightly larger weighting of the sample toward the institutions offering graduate work compared to those offering only undergraduate instruction. This would seem to be in accord with the more rapid relative growth of graduate work which has been taking place and which is borne out in some of the later tabulations of this study. The preponderance, however, is in both cases too small to be significant, and on the whole it would seem that the sample upon which this circular is based is a reasonably valid one.

Additional Follow-Up on Special Programs

After the "books were closed" on the acceptance of questionnaires and tabulation of their contents had started, a second follow-up was sent to the 47 institutions which had not replied up to that time. This covered only questions IV–A and IV–B of the questionnaire, which sought information about two special types of programs, the "three-two" plan and the 5-year undergraduate engineering curriculums (excluding "three-two" and cooperative programs). Although the major purpose of this study is to analyze general trends in engineering education rather than to accumulate itemized statistics, it was also desired to establish a complete directory of institutions offering these two special types of programs. Such a directory of course requires 100 percent coverage if it is to be accurate.

By means of a third followup, complete coverage of the engineering colleges was achieved with respect to these two programs. They are reported in the section entitled *Development of Special Programs*, and in tables O, P, Q, and R.

II. Trends in Curriculums Offered

DEVELOPMENTS in the number and variety of engineering curriculums offered in the colleges and universities, in the numbers which have qualified for accreditation, and in the numbers which have been discontinued constitute the first of the fundamental trends in engineering education with which this study is concerned.

During the period covered by this study there have been increases in the total number of curriculums offered, both those accredited by ECPD and those not so accredited. There have also been a fairly large number of curriculums discontinued during the period, with a much larger percentage of discontinuation among those not recognized by ECPD accreditation than among those which are so recognized.

This section presents data on the number and variety of engineering curriculums offered during the academic year 1948–49, those established since that time, those which have been discontinued since June 1949, and those still in operation. The curriculums are divided into two general groups. The first, which is labeled "ECPD-recognized," consists of those curriculums which prior to the fall of 1959 had been recognized by ECPD through accreditation in at least one institution. The second group, labeled "other," contains all other curriculums.

Another subdivision of curriculums is also used in this bulletin, which cuts directly across the two groups named above. These two groups are "old" and "new" curriculums. "Old" curriculums are those which were reported as being in operation in the academic year 1949, while "new" curriculums are those which have been established since June 1949.

"Old" Curriculums Offered

Data reported by respondents on curriculums ("old") which were offered during academic year 1948–49 (academic year 1949) are tabulated in detail by curriculum and by region in basic table 1 (in app. I). Information is included as to the accreditation status of each curriculum both before and after June 1949, and as to those curriculums which have been discontinued since that date. Regional and national subtotals are shown for ECPD-recognized curriculums and for "other" curriculums (see definitions in introduction), and regional and national totals.

Table C, which is basically a condensation of basic table 1, shows for each region and for the Nation the status during academic year 1959 of "old" curriculums, subdivided into ECPD-recognized, "other," and total.

The number of ECPD-recognized curriculums and options offered in academic year 1949 in the reporting institutions in each region is shown in column 2, totaling 824 for the Nation. The number of these curriculums in each region which were then accredited to ECPD is shown in column 3, totaling 459 for the Nation, or 56 percent of the total number of curriculums.

Column 4 indicates that additional numbers of these curriculums were accredited by ECPD at some later date, a total of 144 for the Nation, or 17 percent of the total number offered in academic year 1949. This means that a total of 603 of the "old" curriculums received accreditation by ECPD sometime prior to academic year 1959. This is 73 percent of the total number which were offered during academic year 1949.

The number of the curriculums offered in academic year 1949 in each region which had been discontinued prior to the date of the questionnaire are listed in column 5, a total of 67 for the Nation, or 8 percent of the total number offered.

These figures indicate that in fields which have been recognized by ECPD there are still 154 curriculums in operation which were in operation during academic year 1949 and which had not been accredited by ECPD up to the fall of 1959. The number of such curriculums in each region is shown in column 6.

Table C.—"Old" curriculums: Status during academic year 1959 of curriculums and options offered during academic year 1949; by ECPD-recognized and "other," by region

[Details in basic table 1]

Region	ECPD-recognized					"Other"			Total		
	Offered in AY 1949	Accredited in AY 1949	Accredited later	Discontinued	Still unaccredited	Offered in AY 1949	Discontinued	Still being offered	Offered in AY 1949	Discontinued	Still being offered
1	2	3	4	5	6	7	8	9	10	11	12
United States total	**824**	**459**	**144**	**67**	**154**	**145**	**74**	**71**	**969**	**141**	**828**
I. East	209	135	31	13	30	34	12	22	243	25	218
II. South	155	94	19	9	33	25	13	12	180	22	158
III. South Central	82	36	24	9	13	13	7	6	95	16	79
IV. Midwest	241	124	49	26	42	49	27	22	290	53	237
V. Mountain	61	34	11	4	12	5	3	2	66	7	59
VI. Pacific	70	32	8	6	24	19	12	7	89	18	71
VII. Outlying	6	4	2	0	0	0	0	0	6	0	6

The number of "other" curriculums offered in each region during academic year 1949 appear in column 7, totaling 145 for the Nation, and column 8 lists the number in each region which had been discontinued sometime prior to the fall of 1959, totaling 74 for the Nation, or 51 percent of the total of such curriculums.

Column 9 shows for each region and for the country the number of "other" curriculums which were offered in academic year 1949 and were still in operation at the time of the questionnaire.

The total number of curriculums offered in the institutions during academic year 1949 appear in column 10. It is simply the sum of columns 2 and 7. The total for the Nation is 969. Column 11 indicates the total number of these curriculums which had been discontinued up until the fall of 1959 (col. 5 plus col. 8), totaling 141 for the Nation, or 15 percent of the total number which were offered during academic year 1949.

The total number of curriculums in each region which were offered in academic year 1949 and were still being offered in the fall of 1959 when the questionnaire was circulated are shown in column 12. This number is equal to column 10 minus column 11.

It is interesting to note that the "mortality" among "other" curriculums has been much larger proportionately than among the ECPD-recognized curriculums (51 percent versus 8 percent), but there are still extant more of these "other" curriculums than there are of the ECPD-recognized curriculums. Evidently the urge for experimentation has been with us continuously through the period covered by this study.

Complete details of the figures shown in table C will be found in basic table 1 (in app. I), which gives the information for each individual curriculum in each region.

"New" Curriculums Offered

Data reported by respondents on curriculums established since June 1949 ("new" curriculums) are tabulated in basic table 2 (in app. I) in detail by curriculum and by region. This table is similar to basic table 1 except for the omission of the category offered during academic year 1949, which obviously is not applicable. As in basic table 1, regional and national subtotals are shown for ECPD-recognized and for "other" curriculums, and regional and national totals.

Table D.—"New" curriculums: Status during academic year 1959 of curriculums and options established since June 1949; by ECPD-recognized and "other," by regions

[Details in basic table 2]

Region	ECPD—recognized				"Other"			Total		
	Number established	Number accredited	Number discontinued	Still being offered	Number established	Number discontinued	Still being offered	Number established	Number discontinued	Still being offered
1	2	3	4	5	6	7	8	9	10	11
United States total	**164**	**40**	**10**	**154**	**127**	**19**	**108**	**291**	**29**	**262**
I. East	32	10	1	31	31	0	31	63	1	62
II. South	23	3	0	23	15	0	15	38	0	38
III. South Central	22	10	2	20	5	2	3	27	4	23
IV. Midwest	47	10	6	41	53	16	37	100	22	78
V. Mountain	10	1	1	9	7	1	6	17	2	15
VI. Pacific	26	6	0	26	15	0	15	41	0	41
VII. Outlying	4	0	0	4	1	0	1	5	0	5

Table D, a condensation of basic table 2, contains information on "new" curriculums in a form similar to that used in table C for "old" curriculums. It should be borne in mind that "new" applies to the individual institution offering the curriculum and means that *for that institution* it is a "new" curriculum. It may or may not be included in the list of "old" curriculums offered during academic year 1949 in some other institution.

The number of ECPD-recognized curriculums established in each region between June of 1949 and the fall of 1959 are shown in column 2, totaling 164 for the Nation.

Of these curriculums the number now accredited by ECPD in each region are shown in column 3, totaling 40 for the Nation, or 24 percent of the total.

The number of these "new" curriculums in each region which had been discontinued up to the fall of 1959 are shown in column 4, totaling 10 for the Nation, or 6 percent of the total.

The number of ECPD-recognized curriculums which have been established in each region since June 1949 and which were in operation at the time of the questionnaire appear in column 5, totaling 154 for the Nation, or 94 percent of the total number of new curriculums established.

Columns 6 and 7 give the number of "other" curriculums established since 1949, totaling 127, and the number discontinued up to September 1959, a total of 19, or 15 percent of the total.

The number of "other" curriculums still being offered in each region at the time of the questionnaire are shown in column 8, totaling 108 for the Nation, or 85 percent of the total "other" curriculums established since June 1949.

The total of all "new" curriculums in each region appears in column 9, totaling 291 for the Nation, of which, according to column 10, 29 have been discontinued (10 percent).

The total number of these curriculums still in operation in each region in the fall of 1959 are shown in column 11, totaling 262 for the Nation, or 90 percent of the total number of "new" curriculums established since June 1949.

As is true in the "old" curriculums, among the "new" curriculums the percentage of "other" curriculums discontinued is much larger than is the percentage discontinued among the ECPD-recognized curriculums (15 percent versus 6 percent).

Complete details will be found in basic table 2 in appendix I, showing for each curriculum the number offered, number accredited, and number discontinued, for each region and for the Nation.

Number of Differently Named Curricular Fields

It should be borne in mind that the curriculums appearing in detail in basic tables 1 and 2 and summarized in text tables C and D are listed as reported by the institutions on the returned questionnaires. It is entirely possible that different institutions have adopted different names for what are essentially the same curriculums, so that several curriculums reported separately could be justifiably combined into one for purposes of tabulation. No attempt at such combinations has been made, partly because it seems that the mere diversity of names used to designate curriculums has some significance, as indicating the desire of the institutions to cover new and rapidly developing fields adequately in their curricular offerings.

For that matter, it is almost certain that curriculums in the same field of engineering offered in different institutions are not exactly alike. It is probably not an exaggeration to state that even in an old, long-established field such as civil engineering the 124 curriculums reported as being offered during academic year 1949 were all slightly different from each other in detail, and that the 134 civil engineering curriculums offered during academic year 1959 differ from each other in even greater degree.

With these precautions, consideration can be given to the total numbers of curriculums as summarized in text tables C and D from basic tables 1 and 2. The number of differently named curriculums can be determined by careful inspection of basic tables 1 and 2. However, some confusion may arise because a curriculum listed in this study as "new" in one institution may be the same as one listed as "old" in another institution.

To obviate at least this last difficulty, basic table 6 (in app. I) has been prepared. It contains data on numbers of curriculums offered and degrees conferred in academic years 1949 and 1959. Curriculums are grouped by *name* with no distinction between "old" and "new" curriculums. Table E is a condensation of certain data in basic table 6 dealing with numbers of curriculums. It shows the numbers of differently named fields in which curriculums were offered during academic years 1949 and 1959, for three major categories and national totals.

The major categories are (1) ECPD-recognized, (2) "other" curriculums which were offered in academic years 1949, and (3) "other" curriculums which have been established since June 1949. Curriculums in categories (1) and (2) may appear in previous tables either as "old" or "new." Those in category (3) are all listed as "new."

To summarize briefly the data on numbers of differently named curricular fields which appear in table E, in academic year 1949 ECPD-recognized curriculums were offered in 20 named fields of engineering. As this study is organized, the same 20 fields are used for listing the ECPD-recognized curriculums in academic year 1959, although, as has been mentioned previously, five additional fields have been recognized by ECPD since 1949. They are not used in this study because the list in effect when the questionnaire was sent out did not contain them.

Table E.—Differently named curricular fields: Number and percent in academic years 1949 and 1959; by ECPD-recognized and "other"

[Details in basic table 6]

Categories of curriculums	Academic year 1949		Academic year 1959		Academic year 1959 as percent o academic year 1949
	Number	Percent	Number	Percent	
1	2	3	4	5	6
United States total	**75**	**100**	**86**	**100**	**115**
ECPD-recognized	20	27	20	23	100
"Other" listed in academic year 1949	55	73	41	48	76
"Other" listed since June 1949	------	------	25	29	--------
Total "other"	55	73	66	77	120

The numbers of curriculums in the 20 fields recognized in 1949 by ECPD do not appear in table E (which deals with curricular *fields*), but are included in basic table 6 and in table I, and can be verified in tables C, D, and H. The total number of such curriculums grew from 824 in academic year 1949 to 911 in academic year 1959, an increase of 11 percent.

Curriculums were offered under 55 "other" named fields in academic year 1949. By September 1959, 14 of these fields, or 25 percent, had been dropped and were no longer in existence in the responding institutions. Five were still offered, but no degrees were conferred in them during academic year 1959.

The 14 curriculums which had disappeared were:

Aeronautical Mechanics
Aircraft Maintenance
Application and Sales
Applied Physics
Biochemistry
Construction and Drainage

- Design
- Heat Power
- Highway Transportation
- Highways
- Jet Propulsion
- Maintenance Engineering
- Petroleum Production
- Railway Engineering

The five curriculums still in existence in which no degrees were conferred during academic year 1959 are:

- Law and Engineering Law
- Municipal
- Soil Conservation
- Structural
- Traffic

Between June 1949 and September 1959, 29 new named fields had appeared among the "other" curriculums offered in the responding institutions. Of these, four had been dropped before September 1959.

These were:

- Automotive
- Refrigeration
- Servo-mechanisms
- Surveying

The remaining 25 new fields are listed in basic table 6. In eight of these fields no undergraduate or graduate degrees were conferred during academic year 1959, as is shown in table 6.

The numbers of *curriculums* offered in "other" fields do not appear in table E, but are summarized in table I and detailed in basic table 6. Those in fields named in the reports for academic year 1949 have increased from 145 in academic year 1949 to 147 in academic year 1959, an increase of 1 percent. Those shown as "other" listed since June 1949 numbered 32 in academic year 1959. Adding these to the "other" listed in academic year 1949 list of 147 gives a total of 179 "other" curriculums offered in academic year 1959, an increase of 23 percent over the 145 "other" curriculums reported for academic year 1949.

Trend Toward Greater Emphasis on Graduate Education

The increased emphasis on graduate education is indicated by the fact that in Academic Year 1949, curriculums in 23 differently named fields (table E and basic table 6) led *only* to the B.S. degree, and those in 5 differently named fields led *only* to graduate degrees. In academic year 1959, curriculums in 17 differently named fields led *only* to the bachelor's degree, and those in 5 differently named fields led *only* to graduate degrees. In each year in the remaining fields, 47 in 1948–49 and 65 in 1958–59, curriculums led to degrees at both levels. This will be discussed further in a later section of this report entitled *Fields of Most Rapid Growth.*

III. Trends in Degrees Conferred

THE SECOND of the fundamental trends in engineering education with which this study is concerned deals with the numbers of degrees conferred in the various curriculums which were considered in the preceding section of this bulletin.

During the period covered by this report, while the number of "old" curriculums has decreased by 14 percent, the number of bachelor's degrees conferred in them has decreased by 18 percent, while the number of graduate degrees has increased by 14 percent. Bachelor's degrees decreased by a smaller percentage among the ECPD-recognized curriculums than among the "other" curriculums. At the same time, in the ECPD-recognized curriculums the increase in graduate degrees was much larger than in the "other" curriculums.

The decrease in bachelor's degrees in this group of "old" curriculums was partially offset by the number of degrees granted in the "new" curriculums which were established between 1949 and 1959, resulting in a net decline of bachelor's degrees in engineering from 1949 to 1959 of about 13 percent. The graduate degrees granted in "new" curriculums brought the total increase in graduate degrees up to 56 percent. These compare to a growth in all bachelor's degrees in all fields including engineering of 5 percent, and a corresponding growth of graduate degrees of 41 percent.

This section will analyze the changes in degrees at both the graduate and undergraduate levels, under the same categories used in the study of curriculums; namely, the division into "old" and "new" curriculums, and the cross-classification of ECPD-recognized and "other" curriculums.

In the preceding section it was pointed out that the lists of curriculums summarized in tables C and D are not entirely mutually exclusive. There is duplication between the lists, since a "new" curriculum for one institution may be an "old" curriculum for another institution. The same precaution applies in this section which deals with numbers of degrees conferred.

Table F is a condensation of basic table 3 found in appendix I which sets forth details of degrees granted in "old" curriculums. Table G is a condensation of basic table 4 which gives similar information for "new" curriculums.

Table H brings the two tables together and shows the total number of degrees granted in both "old" and "new" curriculums during the academic year 1958–59.

Degrees Conferred in "Old" Curriculums

Data reported by "respondents" on degrees conferred in "old" curriculums during academic years 1949 and 1959 are tabulated in detail by curriculum and by region in basic table 3, subdivided into undergraduate and graduate levels. Regional and national subtotals are shown for ECPD-recognized and "other" curriculums, and regional and national totals.

Table F summarizes the data on degrees granted in "old" curriculums which are contained in basic table 3, in a form more readily comparable to other text tables.

The number of bachelor's degrees granted in the ECPD-recognized curriculums for academic years 1949 and 1959 are set forth in columns 2 and 4, showing national totals of bachelor's degrees to have declined from 34,650 to 28,667, a decline of 17 percent. At the same time graduate degrees in these curriculums, as shown in columns 3 and 5, were increasing from 3,865 to 5,595, an increase of 45 percent.

Table F.—"Old" curriculums: Number of degrees conferred in academic years 1949 and 1959 in curriculums and options which were offered in academic year 1949; by ECPD-recognized and "other"; by level, by region

[Details in basic table 3]

Region	ECPD-recognized				"Other"				Total			
	1948-49		1958-59		1948-49		1958-59		1948-49		1958-59	
	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate
1	2	3	4	5	6	7	8	9	10	11	12	13
United States total	**34, 650**	**3, 865**	**28, 667**	**5, 595**	**1, 738**	**207**	**1, 129**	**234**	**36, 388**	**4, 072**	**29, 796**	**5, 829**
I. East	9, 286	1, 505	7, 677	2, 501	782	122	232	175	10, 068	1, 627	7, 909	2, 676
II. South	5, 561	324	5, 247	475	301	4	357	11	5, 862	328	5, 604	486
III. South Central	2, 868	140	2, 215	265	171	6	66	4	3, 039	146	2, 281	269
IV. Midwest	13, 262	1, 262	9, 948	1, 570	328	44	342	15	13, 590	1, 306	10, 290	1, 585
V. Mountain	1, 766	144	1, 568	141	65	3	11	6	1, 831	147	1, 579	147
VI. Pacific	1, 870	489	1, 923	640	91	28	121	23	1, 961	517	2, 044	663
VII. Outlying	37	1	89	3	0	0	0	0	37	1	89	3

Similar information for the "other" curriculums offered during academic year 1949 appears in columns 6, 7, 8, and 9, showing a decline in bachelor's degrees from 1,738 to 1,129, or 35 percent, and an increase in graduate degrees from 207 to 234, or 13 percent.

The totals for the two categories of curriculums are tabulated in columns 10, 11, 12, and 13. The national totals show a decline in bachelor's degrees from academic years 1949 to 1959 of from 36,388 to 29,796, or 18 percent, and a simultaneous increase in the graduate degrees from 4,072 to 5,829, or 43 percent.

In a later section of this report, *Fields of Most Rapid Growth*, comparisons will be drawn between the trends shown in table F and basic table 3 and those for total college degrees in all fields, including engineering.

Degrees Conferred in "New" Curriculums

Basic table 4 (in app. I), displays the data reported by respondents on degrees conferred in "new" curriculums during the first year in which degrees were granted in the individual curriculum and in academic year 1959. (The first year will therefore vary between institutions and between curriculums.) Except for the substitution of "first year" for "academic year 1949," the column headings in basic table 4 are the same as those in basic table 3. The same regional and national subtotals and totals are shown, and the same division between ECPD-recognized and "other" curriculums.

Table G summarizes the data contained in basic table 4 in the same way table F does for the data in basic table 3.

Because of the variation noted above in the first year in table G, direct comparisons between first year and 1958-59 are not mathematically feasible. However, it can readily be seen that there has been a marked growth in number of bachelor's degrees offered in both the ECPD-recognized and the "other" categories, and that the growth has been much larger proportionately among the ECPD-recognized curriculums than among the "other" curriculums.

At the graduate level the number of degrees has increased under both categories of curriculums, but the growth has been somewhat smaller proportionately in the ECPD-recognized curriculums than in the "other" curriculums.

Totals for the two categories of "new" curriculums are given in columns 10, 11, 12, and 13, showing increases at both the undergraduate and the graduate level, with the increase being much larger proportionately at the graduate level than at the undergraduate.

These trends will be compared with trends in total college degrees, in all fields including engineering, in the section of this report entitled *Fields of Most Rapid Growth.*

Table G.—"New" curriculums: Degrees conferred in first year degrees were granted and in academic year 1959 in curriculums and options established since June 1949; by ECPD-recognized and "other"; by level, by region

[Details in basic table 4]

Region	ECPD-recognized				"Other"				Total			
	First year		1958–59		First year		1958–59		First year		1958–59	
	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate
1	2	3	4	5	6	7	8	9	10	11	12	13
United States total	**600**	**44**	**1, 591**	**183**	**221**	**71**	**367**	**329**	**821**	**115**	**1, 958**	**512**
I. East	117	5	290	63	70	23	125	85	187	28	415	148
II. South	38	8	149	14	78	1	87	7	116	9	236	21
III. South Central	70	0	270	15	1	0	1	2	71	0	271	17
IV. Midwest	197	20	494	41	60	25	116	179	257	45	610	220
V. Mountain	13	1	50	6	10	0	24	11	23	1	74	17
VI. Pacific	160	10	323	44	2	22	14	45	162	32	337	89
VII. Outlying	5	0	15	0	0	0	0	0	5	0	15	0

Degrees Conferred During Academic Year 1959

All the data on degrees conferred in academic year 1959 have been brought together in basic table 5 (in app. I). Here are reported for each curricular field named in basic tables 3 and 4 the number of curriculums offered in academic year 1959 and the number of bachelor's, master's, and doctor's degrees conferred, all subdivided into "old" and "new" curriculums and total. Subtotals for each category are shown for ECPD-recognized and "other" curriculums, and national totals for all curriculums.

Table H subdivides the national totals contained in basic table 5 into regional totals, with subdivisions between "old" and "new" curriculums, but not between ECPD-recognized and "other."

The number of "old" curriculums in each region and in the Nation is indicated in column 2, which is a repetition of column 12 in table C. Similarly, the number of "new" curriculums in the various regions and in the Nation is shown in column 6, which is a repetition of column 11 in table D.

The numbers of degrees shown in table H are also taken directly from preceding tables, except that in table H the graduate degrees have been subdivided into master's and doctor's.

Table H.—"Old" and "new" curriculums: Number of curriculums offered and degrees conferred in academic year 1959 in "old" and "new" curriculums and options; by level, by region

[Details in basic table 5]

Region	"Old" curriculums				"New" curriculums				Total			
	Number	Number of degrees conferred			Number	Number of degrees conferred			Number	Number of degrees conferred		
		B.S.	M.S.	Ph. D.		B.S.	M.S.	Ph. D.		B.S.	M.S.	Ph. D.
1	2	3	4	5	6	7	8	9	10	11	12	13
United States total	**828**	**29, 796**	**5, 183**	**646**	**262**	**1, 958**	**470**	**42**	**1, 090**	**31, 754**	**5, 653**	**688**
I. East	218	7, 909	2, 396	277	62	415	139	21	280	8, 324	2, 535	298
II. South	158	5, 604	450	36	38	236	18	3	196	5, 840	468	39
III. South Central	79	2, 281	257	12	23	271	17	0	102	2, 552	274	12
IV. Midwest	237	10, 290	1, 342	246	78	610	200	13	315	10, 900	1, 542	259
V. Mountain	59	1, 579	136	11	15	74	17	0	74	1, 653	153	11
VI. Pacific	71	2, 044	599	64	41	337	79	5	112	2, 381	678	69
VII. Outlying	6	89	3	0	5	15	0	0	11	104	3	0

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This table indicates, for example, that in academic year 1959 the totals for the responding institutions are, at the bachelor's level, 29,796 degrees granted in 828 "old" curriculums and 1,958 degrees in 262 "new" curriculums, a total of 31,754 bachelor's degrees in 1,090 curriculums. Similarly, master's degrees numbered 5,183 in "old" curriculums and 470 in "new" ones, for a total of 5,653. Doctor's degrees numbered 646 in "old" curriculums and 42 in "new" ones, for a total of 688.

Degrees Conferred in Different Curricular Fields

It must be remembered that the data on degrees which appear in detail in basic tables 3 and 4 and in summary in tables F, G, and H need to be considered with the same precautions which were mentioned in connection with numbers of curriculums appearing in basic tables 1 and 2 and summarized in tables C, D, and E. In all these tables, curriculums are listed as reported by the institutions on returned questionnaires. It is entirely possible that different institutions have adopted different names for what are essentially the same curriculums. It is quite probable that there are differences in detail between institutions in curriculums in the same field, and that these differences tend to increase with the passage of time. It is certain that some of the curriculums listed as "new" curriculums in certain institutions are the same (at least in name) as some of those listed as "old" curriculums in other institutions.

As was mentioned in the section on *Trends in Curriculums Offered*, basic table 6, which groups data on numbers of curriculums offered and degrees conferred by *name* with no distinction between "old" and "new," has been prepared to obviate at least this last difficulty.

Table I is essentially a condensation of basic table 6. It contains the major subtotals shown in basic table 6 of the numbers of *differently named* curriculums offered and the numbers of bachelor's and graduate degrees conferred therein in academic years 1949 and 1959, all subdivided into ECPD-recognized and "other" curricular fields. To these it adds percentage distributions of curriculums and degrees for each category of curricular fields.

Table I also contains, as does basic table 6, the ratios of numbers of curriculums and degrees for academic year 1959 to the corresponding number for academic year 1949. These ratios, which hereafter will be called "expansion ratios," will be used extensively in the next section of this report, *Fields of Most Rapid Growth.*

Table I.—Differently named curricular fields: Number and percent of curriculums offered and degrees conferred in academic years 1949 and 1959; by ECPD-recognized and "others"

[Details in basic table 6]

Categories of curriculums	Curriculums offered					Bachelor's degrees conferred					Graduate degrees conferred				
	Academic year 1949		Academic year 1959		Academic year 1959 as percent of academic year 1949	Academic year 1949		Academic year 1959		Academic year 1959 as percent of academic year 1949	Academic year 1949		Academic year 1959		Academic year 1959 as percent of academic year 1949
	Number	Percent	Number	Percent		Number	Percent	Number	Percent		Number	Percent	Number	Percent	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
United States total	**969**	**100**	**1,090**	**100**	**113**	**36,388**	**100**	**31,754**	**100**	**87**	**4,072**	**100**	**6,341**	**100**	**156**
ECPD-recognized	824	85	911	84	111	34,650	95	30,258	95	87	3,865	95	5,778	91	149
"Other" listed in academic year 1949	145	15	147	14	101	1,738	5	1,415	4	81	207	5	481	8	232
"Other" listed since June 1949			32	2				81	(1)				82	1	
Total "other"	145	15	179	16	123	1,738	5	1,496	5	86	207	5	563	9	272

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[1] Less than 0.5 percent

IV. Fields of Most Rapid Growth

THE DATA thus far presented in this study suggest the desirability of formulating some method of determining which curricular fields have enjoyed the most rapid rate of growth during the period covered by the study. There are many ways in which this kind of a comparison can be made. The simplest is to compare rates of growth in numbers of curriculums, or of undergraduate degrees, or of graduate degrees. These three comparisons are set forth in this section, and the results lead the writer to believe that it would be preferable to devise some method of combining these three measures into one overall rating for comparing different curricular fields with each other.

A method of making such a rating has been devised, and is set forth following the three comparisons mentioned above. Under this method of rating curricular fields, those which have enjoyed the greatest percentage of growth over the period covered by this study lie in the *new* fields of nuclear engineering, plastics engineering, and paper and pulp engineering, followed closely by the more *scientific* branches of engineering, of engineering physics, geophysical engineering, engineering mathematics, and engineering science. Petroleum engineering, industrial engineering, agricultural engineering, and electrical engineering are the remaining fields in which the percentage of growth has been above the average for all engineering fields.

Data Available for Study of Comparative Growth

Data thus far presented dealing with numbers of curriculums are in three categories: (1) "old" curriculums offered in academic year 1949 (table C and basic table 1), (2) "new" curriculums established since June 1949 (table D and basic table 2), and (3) differently named curricular fields (table E and basic table 6). Data on degrees conferred have been presented in four categories: (1) in "old" curriculums in operation in academic year 1949 (table F and basic table 3), (2) in "new" curriculums established since June 1949 (table G and basic table 4), (3) in combined "old" and "new" curriculums (table H and basic table 5), and (4) in differently named curriculums (table I and basic table 6).

Of these various tables those which give the most meaningful figures as to comparative growth of different segments of engineering education are table I and basic table 6. The data in those tables make it possible to make comparisons of growth either on the basis of the number of curriculums offered or on the number of degrees conferred therein. The following paragraphs will discuss both these methods briefly.

Number of Curriculums

The number of curriculums offered during academic years 1949 and 1959 in the various fields of engineering are listed in columns 2 and 3 of basic table 6. The subtotals and totals at the top of these columns are repeated in table I in columns 2 and 4, and in column 3 and 5 these are converted into percentages of the total number of engineering degrees in the United States for each of the 2 years. In column 4 of basic table 6 are shown the ratio for each field of engineering of the numbers of curriculums in academic year 1959 to those offered in academic year 1949. These ratios for the subtotals and total also appear in table I in column 6, and hereafter are called "expansion ratios."

It is clear that the ECPD-recognized curriculums expanded in number to a greater extent than did the "other" curriculums listed in academic year 1949. However, if to the last named group be added the group of "other" curriculums listed since June 1949, the total of "other" curriculums shows an expansion ratio of 133 percent, compared to a ratio of 111 percent for the ECPD-recognized curriculums. Under this method of comparison, therefore, the "other" curriculums have enjoyed a greater proportion of growth in number than have the ECPD-recognized curriculums.

Nine of the ECPD-recognized curriculums have expansion ratios larger than the 113 percent shown for all engineering curriculums in the country. Arranged in the order of magnitude of the ratios, these are:

Curriculum	*Expansion ratio*
1. Engineering Mechanics	200
2. Industrial Engineering	154
3. Geophysical Engineering	133
4. Agricultural Engineering	129
5. Petroleum Engineering	128
6. Metallurgical Engineering	126
7. Engineering Physics	118
8. Ceramic Engineering	117
9. Electrical Engineering	116

Among the "other" curriculums listed in 1949 those with expansion ratios larger than the national average of 113 percent, in the order of magnitude of the ratios, are:

Curriculum	*Expansion ratio*
1. Nuclear Engineering	1,700
2. Engineering Science	475
3. Engineering Mathematics	300
4. Industrial Management	200
5. Paper and Pulp Engineering	200
6. Management Engineering	160
7. Plastic Engineering	150
8. Mineral Engineering	133

Expansion ratios for the "other" curriculums established since June 1949 cannot be computed, since the number of such curriculums in 1949 would in every case be zero, and hence, no matter what the number of curriculums offered in 1959, the expansion ratio would be infinity. Some comparisons of these new curriculums will be made on a different basis later.

Bachelor's Degrees Conferred

A comparison of relative rates of growth in various fields of engineering on the basis of the number of bachelor's degrees conferred can be made by means of the data in columns 5 and 6 of basic table 6, which show the number of such degrees conferred in each of these years. The subtotals and totals contained in basic table 6 are repeated in table I in columns 7 and 8, and are converted into percentages of the total engineering bachelor's degrees in the United States in columns 9 and 10. In column 7 of basic table 6 are given the ratio for each curriculum of the number of degrees granted in academic year 1959 to the number granted in academic year 1949 (the expansion ratio). These expansion ratios are repeated for the major groups of curriculums in column 11 of table I.

It will be noted that in all the major groupings the number of bachelor's degrees conferred in academic year 1959 was smaller than the number conferred in academic year 1949, the average for the United States being 87 percent.

Comparing curriculums on this basis the ECPD-recognized curriculums had a slightly smaller decrease than did the "other" curriculums named in academic year 1949, or the total of all "other" degrees. The difference, however, is quite small.

The ECPD-recognized curriculums in which the expansion ratio for bachelor's degrees is larger than the national average of 87 percent are, in the order of magnitude of the ratio:

Curriculum	*Expansion ratio*
1. Engineering Physics	133
2. Naval Architecture and Marine Engineering	133
3. Geophysical Engineering	124
4. Petroleum Engineering	118
5. Ceramic Engineering	116
6. Aeronautical Engineering	116
7. Sanitary Engineering	100
8. Electrical Engineering	100
9. Geological Engineering	100
10. Industrial Engineering	95
11. Metallurgical Engineering	95
12. Agricultural Engineering	93

Among the "other" curriculums listed in academic year 1949 those having an expansion ratio for bachelor's degrees larger than the national average of 87 percent are, in the order of magnitude of the ratio:

Curriculum	*Expansion ratio*
1. Nuclear Engineering	Infinite
2. Engineering Mathematics	Infinite
3. Plastic Engineering	Infinite
4. Furniture Manufacturing	Infinite
5. Industrial Management	1,400
6. Electronics	308
7. Communications	304
8. Physical Metallurgy	300
9. Paper and Pulp	267
10. Engineering Science	211
11. Welding	200
12. Air Conditioning, Heating, and Ventilating	196
13. Power Engineering	136
14. Natural Gas	100

The first four expansion ratios in this table indicate the danger inherent in this kind of computation, which has previously been mentioned. In these four fields no bachelor degrees were granted in academic year 1949, and hence the ratio of whatever number is granted in 1959 to the 1949 number is infinite. This simply means that these are new fields of engineering education which have developed, and some other method of comparing them with the older fields will need to be developed. This will be done later.

No listing is presented for the "other" curriculums established since June 1949, since in every case the preceding paragraph applies. Some comparisons of these degrees will be made later on a different basis.

Graduate Degrees Conferred

A third possible basis for comparing growth is by the use of numbers of graduate degrees conferred, which are shown for the 2 academic years concerned in columns 8 and 9 of basic table 6. These numbers for the subtotals and totals at the top of basic table 6 are repeated in table I in columns 12 and 14, and in columns 13 and 15 are converted into percentages of the total number of graduate engineering degrees conferred in the United States in each of the years.

The ratios of the number of graduate degrees conferred in academic year 1959 to those conferred in the same field in academic year 1949 (the expansion ratio) are shown in column 10 of basic table 6. The ratios for the subtotals and totals at the top of the table are repeated in table I, column 16.

These ratios are in marked contrast to those for bachelor's degrees, in that there has been a marked increase in the number of graduate degrees in all the major categories, with ratios larger than those for numbers of curriculums, and in distinct contrast to the decreases in the numbers of bachelor's degrees.

At the graduate level the "other" curriculums have had a much larger expansion in number of graduate degrees conferred than have the ECPD-recognized curriculums. This indicates a marked tendency for graduate work to pioneer in new fields.

Attention is called to item 3 in the section on *General Comments from Deans*, which bears directly on the importance of graduate work.

The ECPD-recognized curriculums with expansion ratios for graduate degrees conferred which are larger than the national average of 156 percent are, in the order of magnitude of the ratios:

Curriculum	*Expansion ratio*
1. Engineering Physics	1,600
2. Geophysical Engineering	300
3. Petroleum Engineering	273
4. Agricultural Engineering	256
5. Engineering Mechanics	243
6. Industrial Engineering	221
7. General Engineering	196
8. Electrical Engineering	192
9. Naval Architecture and Marine Engineering	164

Among the "other" curriculums listed in academic year 1949 those with expansion ratios for graduate degrees conferred which are larger than the national average of 156 percent are, in the order of magnitude of the ratio:

Curriculum	*Expansion ratio*
1. Nuclear Engineering	Infinite
2. Transportation Engineering	Infinite
3. Communications Engineering	Infinite
4. Production Engineering	Infinite
5. Process Engineering	Infinite
6. Economic and Industrial Engineering	1,300
7. Mineral Engineering	1,200
8. Management Engineering	1,057
9. Engineering Mathematics	625
10. Paper and Pulp Engineering	600
11. Plastics Engineering	300
12. Engineering Science	233
13. Petroleum Refining Engineering	200

The first five expansion ratios in this list again indicate the danger inherent in this kind of computation, which has previously been mentioned. In these five fields no graduate degrees were granted in academic year 1949 and hence the ratio of whatever number is granted in 1959 to the 1949 number is infinite. This simply means that these are new fields of engineering education which have developed, and some other method of comparing them with the older fields will need to be developed. This will be done later.

Fields Established Since June 1949

For the "other" curriculums established since June 1949 data are available only for academic year 1959, and it is therefore impossible to make comparisons with 1949 data.

Engineering management is the only new field in which as many as four curriculums have been established since 1949. Aeronautical science, instrumentation, materials engineering, and sales engineering follow with two each, and only one curriculum has been reported in each of the other fields listed.

The ranking curriculums in terms of numbers of bachelor's degrees conferred in academic year 1959 are:

Engineering Management	46
Tool Engineering	17

In terms of graduate degrees conferred in academic year 1959 the ranking curriculums are:

Instrumentation	34
Aeronautical Science	13
Guidance and Control	11
Air Weapons	9

The expansion ratios for degrees granted which appear in preceding pages may be compared with similar ratios based on the total numbers of bachelor's and graduate degrees granted in all fields of learning (including engineering) in all accredited institutions of higher education in the United States. These can be calculated from data in U.S. Office of Education reports of earned degrees, as follows:

	Degrees granted		
Degree level	*Academic year 1949*	*Academic year 1959*	*Expansion ratio*
Bachelor's	366, 698	385, 151	105
Graduate	55, 813	78, 856	141

Comparisons between these expansion ratios and those for engineering degrees which appear in table I must be made with care. It must be borne in mind that the expansion ratios shown above are based on complete coverage of *all* accredited engineering institutions in the country, while those in table I are based on *partial* coverage of the engineering colleges. However, it has been shown in the section of this report entitled *Institutions Participating in Study* that the respondents in this study constitute a reasonably valid sampling of the engineering colleges of the country, and it is most unlikely that the expansion ratios for *all* engineering degrees, if computed, would differ significantly from those developed on preceding pages.

Therefore, while comparisons between numbers of engineering degrees as shown in table I with those for *all* degrees as shown above are not valid, the expansion ratios for the two groups are comparable within a narrow margin of possible error. On this basis the expansion ratio for engineering bachelor's degrees (87) falls far short of that for *all* bachelor's degrees (105), while the expansion ratio for engineering graduate degrees (156) is much larger than that for *all* graduate degrees (141).

Fields of Most Rapid Growth

It is not intended that the expansion ratios given in the preceding tabulations be treated as mathematical ratios, or that strict mathematical comparisons can be made between the growth rates of the different curriculums. This is particularly true for the "other" curriculums, where in several curriculums no degrees were conferred in 1949, and hence any number of degrees conferred in 1959 would represent an expansion ratio of infinity, as indicated in several instances.

A useful device would be to list the relative ranks of the several curriculums which have expansion ratios larger than the national average in the three categories of curriculums, bachelor's degrees, and graduate degrees. If this is done the only ECPD-recognized curriculums which appear under *all three* categories are (1) engineering physics, (2) geophysical engineering, (3) petroleum engineering, (4) industrial engineering, (5) agricultural engineering, and (6) electrical engineering. In table J these are arranged in the order of magnitude of the average of the ranks under the three categories.

If a similar process be followed for the "other" curriculums the only ones listed under *all three* categories are (1) nuclear engineering, (2) engineering mathematics, (3) plastics engineering, (4) engineering science, (5) paper and pulp engineering. As was done with the ECPD-recognized curriculums, these are arranged in table J in the order of magnitude of the average of the ranks in the three categories.

Table J.—Fields of most rapid growth: Rank order of "expansion ratios" for curriculums which have ratios larger than the national average under *all three* of the categories shown, and the average of the three rank orders for each curriculum

Curriculums	Rank order in categories			Average rank order
	A	B	C	
	Curriculums	Bachelor's degrees	Graduate degrees	
1	2	3	4	5
ECPD-recognized				
Engineering physics	7	1	1	3
Geophysical engineering	3	3	2	3
Petroleum engineering	5	4	3	4
Industrial engineering	2	10	6	6
Agricultural engineering	4	12	4	7
Electrical engineering	8	8	8	8
"Other" curriculums				
Nuclear engineering [1]	1	1	1	1
Engineering mathematics	3	2	9	5
Plastics engineering	7	3	11	7
Engineering science [1]	2	10	12	8
Paper and pulp engineering	5	9	10	8

[1] Have been recognized by ECPD since 1949.

It is interesting to note that in this last classification two of the curricular fields which have been accredited somewhere by ECPD since 1949, nuclear engineering and engineering science, appear in first and fourth place, respectively. The other three new fields approved by ECPD, building and construction, transportation engineering, and welding engineering, do not appear in table J. Building and construction does not appear on any of the expansion ratio lists, transportation engineering ranks second in graduate degrees, and welding engineering ranks eleventh in bachelor's degrees.

This comparison is summarized in table J, which lists each field which has expansion ratios larger than the national averages in *all three* of the categories discussed; namely, number of curriculums, number of bachelor's degrees, and number of graduate degrees. For each field is shown in columns 2, 3, and 4 its rank order in each category, and in column 5 the average of these rank orders. (Engineering physics is listed above geophysical engineering because it ranks first in two categories.)

Table J then represents one possible ranking of the various fields from the standpoint of growth. Other methods of rating will no doubt occur to the reader, but the fields listed in table J will undoubtedly appear near the top of any such list.

Attention is called to the comments from deans of engineering which are cited in the next section, *Trends in Curriculum Revisions.* Many of these are directed primarily toward curriculum content, but they also give an indication of the difficulties inherent in any such comparison as has been outlined above, and hints as to other methods which might be used.

V. Trends in Curriculum Revisions

ONE FACET of the efforts of the engineering colleges to keep abreast of new developments in technology has been illustrated in the proliferation of types of curriculums offered, which has been discussed in preceding sections. Another facet, undoubtedly at least as important and probably even more important, consists of the changes which have been made in existing curriculums without changing the names or without subdividing them into options. Engineering education has been in a state of ferment for many years and numerous committees of ASEE and of other groups have made studies of the content of engineering curriculums. Probably the most important of these studies was the report of the Committee on the Evaluation of Engineering Education made by the committee of ASEE in 1955.

Report on Evaluation of Engineering Education

This report, familiar to engineering educators, made certain basic recommendations concerning the distribution of time in an engineering curriculum designed to prepare students for engineering leadership in 1975 or thereabouts. These suggestions might be briefly summed up as recommending the devotion of an increased proportion of time to "humanistic-social" courses and to the basic science courses, with an accompanying decrease in the amount of time devoted to strictly engineering technology courses.

The gist of the report is contained in table K, which lists the recommendations of the committee as to approximate proportions of scientifically oriented engineering curricula which should be devoted to each of five major blocks of courses.

The mathematically minded will quickly discover that the proposed proportions add up to about 105 percent. This was intentional on the part of the committee, to indicate that its recommendations were not to be considered in any sense as absolute numerical percentages, but rather that, in the opinion of the committee, a scientifically oriented engineering curriculum should contain somewhere near the percentages of each of the five blocks which are set forth in the last column of table K.

Table K.—Time distribution in scientifically oriented curriculums, as recommended by the Committee on the Evaluation of Engineering Education of the American Society for Engineering Education

Block number	Courses included in block	Proportion of the curriculum
1	Humanistic and social studies.	About one-fifth.
2	Mathematics and basic sciences (About equal weight).	About one-fourth.
3	Engineering sciences (Including mechanics of solids, fluid mechanics, thermodynamics, transfer and rate mechanism, electrical theory, nature and properties of materials).	About one-fourth.
4	Sequence of engineering analysis, design and engineering systems (Including the necessary technological background).	About one-fourth.
5	Options or electives (Including fields named above, management, research, or thesis).	About one-tenth.

Changes Reported by Respondents

The discussion which follows attempts to relate changes which have actually been made in engineering curriculums since academic year 1949 to recommendations of the ASEE committee. Institutions were asked in question III of the questionnaire to indicate for the year 1948–49 and the year 1960–61 and as many intermediate years as they wished the percentage of the total curriculum assigned during that year to each of the five major blocks of courses. Practically every institution which answered the questionnaire answered this question. Some time distributions were reported as applying to all engineering curriculums in the institution, others to only one or a few curriculums.

Reports of changes in single curriculums have been treated just the same as those reported for entire institutions, since no mathematical analysis is intended under this question, but merely some general indications of trends. Also there were many institutions which reported changes in several different years, some institutions having changed as many as five times.

The number of changes reported by the institutions in the distribution of time in the engineering curriculums as between these five major blocks is shown in table L for each region and for the Nation.

The number of institutions in each region and in the Nation are shown in column 2. This is a repetition of the same information contained in tables A and B, and is repeated here merely for convenience.

The number of usable replies to this particular question which were received appear in column 3. These numbers are not exactly the same as those reported in tables A and B, since a small number of questionnaires which were usable for other questions were found unusable for this particular question.

The number of institutions in each region which reported that they had made no changes in time distribution as between the major blocks of courses since 1949 are listed in column 4. This totals only 21 institutions out of the 172 responding, or about 12 percent. How closely the time distribution in these institutions may agree with the recommendations of the ASEE committee is not known.

Changes Before and After the ASEE Report

The number of changes which have been made in each of the academic years from 1949 to 1959 are shown in columns 5 to 14, inclusive, and the number of changes definitely proposed for the academic years 1960 and 1961 are listed in columns 15 and 16.

Since the report of the ASEE committee was published in June 1955 it seems worthwhile to compare the number of changes which the institutions had made prior to the appearance of this report with those which have been made since its publication, as shown in the last line of table L. From academic year 1950 through 1955, during a 6-year period, a total of 86 changes were reported. In the ensuing 4 years, academic years 1956 to 1959, inclusive, a total of 113 changes are reported, and for the 2 academic years, 1960 and

Table L.—Curriculum changes: Number of institutions which made or plan changes in the percentages of time assigned to various blocks of courses; by academic year, by region

Region	Number of institutions	Number of usable replies	Institutions reporting no change	Changes made during academic year										Changes planned	
				1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
United States total	**223**	**172**	**21**	**16**	**13**	**7**	**14**	**19**	**17**	**20**	**22**	**19**	**52**	**39**	**75**
I. East	65	53	4	9	2	1	3	5	8	4	5	3	12	11	21
II. South	40	32	2	1	2	1	2	6	3	6	2	6	14	6	17
III. South Central	20	15	0	1	2	1	0	1	2	1	2	2	6	4	9
IV. Midwest	53	37	5	0	4	0	4	4	1	4	8	4	14	10	16
V. Mountain	17	11	0	1	2	3	2	1	2	3	3	2	3	4	8
VI. Pacific	25	19	10	3	1	1	3	1	1	2	2	2	2	4	4
VII. Outlying	3	2	0	1	0	0	0	1	0	0	0	0	1	0	0
Total for periods shown				**86**						**113**				**114**	

1961, 114 changes are reported as definitely being planned. It is quite evident from this distribution that the institutions were already concerned with the readjustments in their curriculums before the report of the ASEE committee appeared, but that its appearance has had a stimulating effect on their activities in trying to improve and bring up to date their engineering curriculums.

Direction of Changes

The direction of changes made in time distribution is at least as important as the number of changes, probably more important.

Table M shows the distribution of the changes shown in table L between those which increased the percentage of time devoted to a particular block and those which decreased it.

Table M indicates that in block 1, the humanistic-social studies, the trend has been very *markedly toward an increase*, there having been 195 increases and 39 decreases reported. In other words, 83 percent of the changes were in the direction of increased emphasis on humanistic-social studies. This compares with 64 percent in block 2, mathematics and basic sciences; 60 percent in block 3, engineering sciences; 38 percent in block 4, engineering analysis, design, and systems; and 45 percent in block 5, options or electives.

Amount of Change

The amount of change is also significant in such comparisons, and table N shows the actual percentage distribution between the five blocks of courses for each of the seven regions for separate years: 1949, the first year of the study; 1955, the year of publication of the ASEE report; 1959, the time of the questionnaire; and 1961, future changes definitely planned. It should be noted that the number of reports on which these percentages were based increases as we move along the calendar, as is also shown in table L.

The net increase in block 1, humanistic and social courses 1949 to 1961, is from 14.5 percent to 18.3, an increase of 26 percent. The 18.3 percent average for all responding institutions corresponds very closely to the ASEE committee recommendation for this group of "about one-fifth."

For block 2, mathematics and basic science, the net increase is from 27.7 percent in 1949 to 29.2 in 1961, an increase of 5 percent. The ASEE committe recommendation for this group of courses is "about one-fourth," so *that the institutions are* somewhat above the committee recommendations.

In block 3, engineering sciences, the increase has been very slight, from 24.1 percent to 24.3, an increase of 1 percent. The ASEE committee recommendation for this group of course is "about one-fourth."

In block 4, engineering analysis, there has been an actual decrease from 23.2 percent in 1949 to 20.5 percent in 1961, a decrease of 12 percent. The ASEE committee recommendation on this group of course is "about one-fourth."

Table M.—Curriculum changes: Number of institutions which made or plan changes in the percentages of time assigned to various blocks of courses and the direction of the change, by region and by blocks of courses

Region	Direction of changes									
	Block 1		Block 2		Block 3		Block 4		Block 5	
	Increase	Decrease	Increase	Decrease	Increase	Decrease	Increase	Decrease	Increase	Decrease
1	2	3	4	5	6	7	8	9	10	11
United States total	**195**	**39**	**150**	**83**	**142**	**94**	**93**	**155**	**101**	**124**
I. East	60	12	54	18	43	24	21	49	34	29
II. South	35	7	26	18	29	16	12	34	24	19
III. South Central	20	2	16	4	12	10	10	11	4	14
IV. Midwest	43	9	26	29	32	26	31	32	22	35
V. Mountain	23	2	16	7	17	7	5	19	9	15
VI. Pacific	13	6	11	7	9	10	13	9	7	11
VII. Outlying	1	1	1	0	0	1	1	1	1	1

In block 5, options and electives, there has been a decrease from 8.6 to 7.7 percent, a decline of 10 percent. The ASEE recommendation for this group of course is "about one-tenth."

Summary

On the whole it would seem that the engineering colleges have been adjusting their curriculums to the needs of the times and that the report of the ASEE committee has had considerable influence on their thinking. No exact mathematical correspondences can be expected in any such collection of data as is here presented, and it is emphasized again that it is not the intension of this circular to provide definite quantitative answers to such questions as what percentage of engineering curriculums should be devoted to humanistic-social studies.

It would be well in this connection to note some of the additional statements which were submitted by engineering deans to the open-ended question constituting the last item in the questionnaire, which asked for their opinions on changes in curriculums or courses needed in the future. These are reported in the section *General Comments by Deans*, where they are numbered for easy reference. Those which are especially pertinent to this section are numbered: 1, 2, 5, 7, 9, 10, 11, 12, 14, and 16.

Table N.—Curriculum changes: Percentage of time devoted to various blocks of courses in 1949, 1955, and 1959, and planned for 1961; by region; and the number of reports received

Region	Block 1 Humanistic and social studies [1]				Block 2 Mathematics and basic science [2]				Block 3 Engineering sciences [2]				Block 4 Engineering analysis, design, and systems [2]				Block 5 Options or electives [3]			
	1949	1955	1959	1961	1949	1955	1959	1961	1949	1955	1959	1961	1949	1955	1959	1961	1949	1955	1959	1961
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
United States total	**14. 5**	**14. 7**	**17. 0**	**18. 3**	**27. 7**	**28. 0**	**28. 9**	**29. 2**	**24. 1**	**23. 8**	**23. 9**	**24. 3**	**23. 2**	**23. 1**	**21. 7**	**20. 5**	**8. 6**	**8. 8**	**7. 7**	**7. 7**
I. East	15. 8	15. 2	17. 8	19. 4	26. 8	27. 8	27. 4	29. 0	25. 0	24. 2	25. 1	24. 5	23. 6	23. 1	22. 2	20. 7	6. 4	7. 2	4. 9	6. 7
II. South	13. 9	14. 5	17. 5	19. 5	27. 8	28. 2	29. 7	28. 7	22. 8	23. 4	23. 6	24. 1	26. 9	24. 9	22. 1	20. 5	7. 8	8. 1	7. 2	7. 5
III. South Central	10. 7	11. 4	15. 2	15. 3	29. 1	28. 8	30. 5	31. 9	24. 0	23. 5	22. 4	24. 7	20. 9	22. 2	21. 2	19. 7	16. 6	15. 6	11. 4	10. 0
IV. Midwest	15. 3	16. 5	17. 6	17. 9	29. 0	28. 5	28. 9	29. 2	24. 2	23. 6	24. 6	25. 5	21. 3	21. 2	20. 6	19. 7	8. 5	8. 3	7. 9	7. 4
V. Mountain	9. 4	8. 8	11. 9	14. 7	29. 8	29. 5	25. 7	29. 9	22. 3	20. 8	21. 6	22. 6	23. 7	25. 6	21. 7	21. 3	11. 1	11. 8	10. 7	9. 4
VI. Pacific	17. 4	17. 3	17. 9	19. 0	24. 0	23. 9	25. 9	26. 5	24. 4	25. 8	22. 3	21. 0	23. 2	24. 1	24. 4	23. 3	7. 5	6. 9	7. 6	7. 6
VII. Outlying	15. 5	13. 3	14. 5	14. 5	27. 5	29. 3	31. 5	31. 8	36. 0	31. 0	30. 3	30. 3	14. 5	14. 3	12. 0	11. 7	6. 5	12. 0	12. 0	12. 0
Number of reports	249	264	280	295	249	264	280	295	249	264	280	295	249	264	280	295	249	264	280	295

[1] Committee on Evaluation recommends "about one-fifth."

[2] Committee on Evaluation recommends "about one-fourth."

[3] Committee on Evaluation recommends "about one-tenth."

VI. Development of Special Programs

THE GROWING tendency of industry to call engineers to managerial and administrative positions has made it increasingly important that engineering education should include such cultural or liberal education as will help engineers to be well-rounded men, able and willing to carry their share of the duties of good citizens, and to understand the social, political, and economic implications of their scientific and engineering activities.

The section of this circular entitled *Trends in Curriculum Revisions* discusses changes in engineering curriculums which have resulted in a more liberal education for engineering students within the standard 4-year program.

This section will consider two special programs which have developed quite largely during the 10-year period covered by this study, both of which extend the time required to earn a bachelor's degree in engineering from 4 years to 5. These are the "three-two" program and the 5-year undergraduate engineering curriculum. A third type of 5-year plan, the cooperative program, is not included because its major objective is different; namely, to combine practical engineering experience with an engineering education.

The cooperative program has been discussed at considerable length in two Office of Education bulletins, *A Survey of Cooperative Engineering Education*, Bulletin 1949, No. 15, and *Cooperative Education in the United States*, Bulletin 1954, No. 11. These bulletins cover the general principles and characteristics of the program fairly adequately, although the lists of institutions conducting such programs are out of date. However, a comprehensive survey of the field has recently been completed by the editor of the *College Blue Book* with the cooperation of the writer of this circular. It contains the largest and most complete list of institutions conducting this type of program that has yet been assembled, and is believed to provide as nearly complete coverage as can be expected from such surveys.

The "Three-Two" Program

The "three-two" plan represents one method of attack on the problem of attempting to combine an engineering education with a liberal education. It consists of a cooperative arrangement between an engineering college and a nonengineering college, under which students are able to pursue combined liberal arts and engineering curriculums. In a few cases the two colleges are parts of the same university. The usual pattern provides that the student attend the nonengineering college for 3 years, taking a program agreed upon between the two institutions, and then attend the engineering college for 2 years. If his work is satisfactorily completed he receives the bachelor of arts from the nonengineering college at the end of his fourth college year, and at the end of his fifth year he receives the bachelor of science degree in engineering from the engineering college.

Apparently the earliest organized three-two plan was at Case Institute of Technology, which had such a program from 1903 to 1927 in cooperation with Adelbert College. A few other institutions have had programs for several years, but much of the growth in popularity in this type of educational program is comparatively recent. In 1950, six engineering colleges were known to be operating such programs. In October 1952 the *New York Times* reported 13 programs. In May 1953, 16 engineering colleges were identified with such programs. An article by the writer of this circular which was published in *Higher Education*, the journal of the Office of Education, in December 1953, listed 25 engineering colleges situated in 11 States which at that time were cooperating with 120 different nonengineering colleges situated in 32 States in the conduct of 188 three-two programs (43 of the nonengineering colleges were cooperating with 2, 3, or 4 engineering colleges each).

Since the publication of the above-named article, the writer has issued several supplementary lists of three-two programs, based on fragmentary information received from various sources. His last tabulation, published in July 1959, showed 42 engineering colleges situated in 19 States cooperating with 164 nonengineering colleges situated in 37 States in the conduct of 266 three-two programs.

The data in this circular on the three-two program are taken directly from the questionnaires returned by the institutions. Following the "closing of the books" on the remaining parts of the questionnaire, special follow-ups were sent in an attempt to assure 100 percent coverage on the three-two programs and the 5-year undergraduate engineering programs. The attempt succeeded, and the data presented in tables O and P represent complete coverage of all engineering colleges in the Nation.

Tables O and P show a total of 55 engineering colleges situated in 26 States, which are cooperating with 224 nonengineering colleges situated in 40 States and two foreign nations in the conduct of 355 three-two programs. (See introduction for definition of State.)

Table O shows the year-by-year development of the three-two program in the engineering colleges of the country in much the same way that changes in curriculum content are shown in table L.

The number of three-two programs which were in operation in each region prior to June 1949 are indicated in column 3. Columns 4 to 13, inclusive, show the number started in each academic year since then. A few programs for which the institutions did not report starting dates are listed in column 14, and column 15 indicates the total number of three-two programs reported as active in each region and in the Nation during academic year 1959. Column 16 shows programs planned for the near future, and column 17 lists three instances in which three-two programs have been discontinued.

As was done in table L, a division is shown at the bottom of table O between programs started before the beginning of the period covered by this study, those started during the years 1950 to 1955, inclusive, and those started later or at unknown dates. This division is in agreement with the division used in table L (before and after the issuance of the ASEE report on the evaluation of engineering education). However, it appears to indicate an opposite trend. In table L the number of changes made in the distribution of time in engineering curriculums increased very markedly after 1955.

Table O shows a much *smaller* number of new three-two programs established since that date than before it. This is probably only natural, since the changes in curriculum content (shown in table L) have been predominantly in the direction of increasing the "humanistic-social" content of engineering curriculums, which is the same fundamental purpose as the one for which the three-two program is designed. It seems quite logical, therefore, that as the one increases more rapidly the other might be expected to increase at a slower rate, which has actually happened.

Table O shows merely the number of engineering colleges which are active in conducting three-two programs. However, in most instances the engineering college cooperates with more than one liberal arts college. In table P the figures in columns 2 and 3 are the same as those in columns 2 and 15 of table O. They indicate for each region the number of engineering colleges in that region which are conducting three-two programs.

Column 4 in table P shows for each region and for the Nation the number of three-two programs in which nonengineering colleges are cooperating with the engineering colleges. This indicates that there are 355 three-two programs in existence in the 55 engineering colleges which offer this plan. However, this does not imply that 355 separate nonengineering colleges are involved, since in many instances a nonengineering college is cooperating with more than one engineering college in this type of program.

It is planned to issue at a later date a separate circular of the Office of Education which will discuss the three-two program more fully and will include a complete directory of engineering and

Table O.—"Three-two" programs: Number of engineering colleges which established or plan "three-two" programs, by academic year; and number which discontinued such programs; by region

Region	Number of engineering colleges	Number of engineering colleges establishing programs during year													Planned for near future	Program discontinued
		Academic year 1949 or earlier	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	Year not stated	Total		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
United States total	**223**	**8**	**2**	**2**	**2**	**7**	**10**	**6**	**4**	**3**	**1**	**3**	**7**	**55**	**4**	**3**
I. East	65	6	0	1	0	0	1	1	1	1	0	0	5	16	2	1
II. South	40	0	0	0	0	0	5	2	0	1	0	0	0	8	1	1
III. South Central	20	0	0	0	0	1	1	0	1	0	0	0	0	3	0	0
IV. Midwest	53	2	2	1	0	6	2	2	1	0	0	0	1	17	0	1
V. Mountain	17	0	0	0	0	0	1	0	0	1	0	2	1	5	0	0
VI. Pacific	25	0	0	0	2	0	0	1	1	0	1	1	0	6	1	0
VII. Outlying	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals in period shown		**8**	**29**						**11**				**7**	**55**	**4**	**3**

Table P.—"Three-two" programs: Number of "three-two" programs in operation during academic year 1959; engineering colleges involved; "three-two" students enrolled in engineering colleges; and students who have received the two degrees; by region

Region	Number of engineering colleges		"Three-two" programs in operation, academic year 1959		
	In region	Having programs	Number	Number of "three-two" students enrolled in engineering colleges fall of 1958	Number of students who have received the two degrees
1	2	3	4	5	6
United States total	**223**	**55**	**355**	**509**	**1, 442**
I. East	65	16	[1] 157	255	1, 189
II. South	40	8	45	34	13
III. South Central	20	3	17	4	16
IV. Midwest	53	17	[2] 98	184	206
V. Mountain	17	5	[1] 13	9	3
VI. Pacific	25	6	25	23	15
VII. Outlying	3	0	0	0	0

[1] Includes a program with a foreign nonengineering college.
[2] Includes two programs with foreign nonengineering colleges.

nonengineering colleges involved in this type of program. Suffice it to say that among the nonengineering colleges participating in the 355 programs shown in column 4 of table P, there are 52 nonengineering colleges which are each cooperating with two engineering colleges, 23 which cooperate with three each, and 10 which cooperate with 4 or more each. In short, 224 nonengineering colleges account for the 355 programs.

Column 5 of table P shows the number of students enrolled in the engineering college part of the combined programs in the fall of 1958, and column 6 shows the number of students who have actually completed the double program and have received the two degrees since the programs were started.

No data are at hand on the numbers of students in the nonengineering part of the three-two programs in the 224 nonengineering colleges which are participating, but the numbers shown for the enrollment in the engineering part of the program and the numbers of students who have actually completed the program indicate quite clearly that numerically the three-two program is not making a very large contribution to the production of engineers for the Nation. However, the combined program does provide a broader and more diversified type of education than is provided by the 4-year engineering curriculum alone.

It is to be presumed that the nonengineering part of the program operates as a screening device to help select the students who have strong aptitudes and abilities for the engineering part of the program. There are other advantages to the combined program which attract many students into it. In some cases it enables a young man to attend a college much nearer to his home than the engineering college from which he hopes to graduate. It has in recent years become international in scope. The Mexico City College and the University of the Andes in Colombia are cooperating with three engineering colleges in the United States in the conduct of four such programs, as indicated in table P.

It is probably safe to say that the three-two program is a worthwhile development in the general field of engineering education, but not a numerically large one. The declining rate of growth shown in table O would appear to indicate that it is not gaining much ground among the engineering colleges, but that it does serve a useful purpose under the proper conditions.

The 5-Year Undergraduate Engineering Curriculum

A second type of special program which has developed fairly rapidly during the period covered by this study is the program which requires 5 years of normal college attendance for the completion of a bachelor's degree in engineering. The 5-year curriculum has been established in some cases with the same fundamental purpose as the "three-two" plan; namely, to give opportunity for greater diversity and for more work in the humanistic-social studies. However, in many instances it has worked out that the extra time is devoted chiefly to more engineering and technical studies, and that the liberal "humanistic-social" content of the curriculums has not been increased notably.

Tables Q and R present the data on this type of program which were reported by the respondents. Replies to this question were received from all engineering colleges in the Nation. In the fall of 1959 a total of ninety-seven 5-year undergraduate engineering curriculums in 17 fields of engineering were offered by 27 institutions situated in all 7 regions. In most instances completion of the 5-year curriculum is required of all candidates for the bachelor's degree, although in a few cases students have the option of either a 4-year or a 5-year curriculum.

A few institutions reported that students who enrolled in the ROTC require 5 years for the completion of an engineering degree. Such curriculums have not been included in this tabulation because they are not, strictly speaking, 5-year engineering curriculums.

Table Q shows the year-by-year development of the 5-year curriculum in the engineering colleges of the country in a manner similar to that used in table L for changes in curriculum content and in table O for the three-two program.

Column 3 indicates the number of 5-year programs which were in operation in each region prior to June 1949. Columns 4 to 13, inclusive, show the number started in each academic year since. Column 14 lists a few programs for which the institutions did not report starting dates, and column 15 indicates the total number of 5-year programs reported as active in each region and in the Nation during academic year 1959.

As was done in tables L and O, a division is shown at the bottom of table Q between programs started before the beginning of the period covered by this study; those started during the years 1950 to 1955, inclusive; and those started later and at unknown dates. This division, as in tables L and O, gives comparative data for the period before and after the issuance of the ASEE report on the evaluation of engineering education.

As in the case of the three-two program, table Q shows a much smaller number of new 5-year programs established since 1955 than in earlier years. Insofar as the establishment of 5-year programs is prompted by the desire to liberalize engineering education this trend is probably only natural, since the same objective is also being served by changes in curriculum content. As shown in table L, such changes have been much more numerous since the ASEE report appeared than before that date. Apparently the engineering colleges as a whole feel that it is more desirable to revise curriculums than to lengthen them.

Table Q.—Five-year undergraduate engineering curriculums: Number established; by academic year, by region

Region	Number of engineering colleges	Number of five-year curriculums established during academic year												
		1949 or earlier	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	Year not stated	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
United States total	**223**	**48**	**2**	**1**	**4**	**1**	**10**	**14**	**1**	**0**	**1**	**3**	**12**	**97**
I. East	65	11	1	1	0	0	3	0	0	0	0	3	11	30
II. South	40	5	0	0	0	0	1	7	0	0	0	0	0	13
III. South Central	20	2	0	0	4	1	1	0	0	0	0	0	1	9
IV. Midwest	53	25	0	0	0	0	0	6	1	0	1	0	0	33
V. Mountain	17	0	1	0	0	0	5	0	0	0	0	0	0	6
VI. Pacific	25	1	0	0	0	0	0	0	0	0	0	0	0	1
VII. Outlying	3	4	0	0	0	0	0	1	0	0	0	0	0	5
Totals in period shown		**48**	**32**						**5**				**12**	**97**

Table R gives a distribution of the 5-year curriculums, in each region and in the Nation, by the field of engineering in which they are offered. It is probably significant that all these fields except one are now recognized by ECPD accreditation in at least one institution, although two fields are not listed in earlier tables of this circular as ECPD-recognized. These are engineering science and welding engineering, both of which have been recognized since the questionnaire was distributed, as stated earlier.

Table R covers *all* engineering colleges, while other tabulations in this study of numbers of curriculums cover only the responding institutions. Comparisons between the numbers of 5-year engineering curriculums and of *all* engineering curriculums are therefore difficult. But an approximate comparison can be made, as outlined below.

The total number of undergraduate engineering curriculums offered by the respondents in academic year 1959 is 1,090, as shown in table H, column 10. The respondents are 77 percent of all engineering colleges (table A, col. 4). If the remaining institutions offer the same number of curriculums per institution, the total for the Nation is 1,415. The ninety-seven 5-year curriculums shown in table R are 6.9 percent of this number. Hence, we may say that 5-year engineering curriculums constitute *about* 7 percent of all undergraduate engineering curriculums. Similar computations for the various regions yield percentages varying from 1 to 71 percent, with five regions ranging from 7 to 13 percent.

This wide range of results indicates the difficulties encountered in trying to make such comparisons for such small numbers of cases, but the ratio of 7 percent is sufficiently accurate to indicate quite clearly that the 5-year engineering curriculum has not yet gained widespread recognition and approval from the engineering colleges. Attention is called to items numbers 6, 13, 15, and 16 in the section of this circular entitled *General Comments by Engineering Deans*. One or two of the deans commented that they thought the 5-year curriculum was spreading, but the evidence collected in this study seems to indicate that it has not yet progressed very far.

Table R.—Five-year undergraduate engineering curriculums: Number offered in academic year 1959; by curriculum, by region

Curriculum	Region							U.S. Total
	I	II	III	IV	V	VI	VII	
1	2	3	4	5	6	7	8	9
All 5-year curriculums	30	13	9	33	6	1	5	97
Aeronautical engineering	0	1	0	2	0	0	0	3
Agricultural engineering	1	1	0	2	0	0	0	4
Architectural engineering	1	0	2	4	1	1	0	9
Building construction engineering	0	1	0	0	0	0	0	1
Ceramic engineering	0	0	0	1	0	0	0	1
Chemical engineering	3	2	2	3	1	0	1	12
Civil engineering	5	2	1	3	1	0	1	13
Electrical engineering	7	2	1	3	1	0	1	15
Engineering physics	3	1	0	1	0	0	0	5
Engineering science	1	0	0	0	0	0	0	1
Geological engineering	0	0	1	2	1	0	0	4
Industrial engineering	1	1	0	1	0	0	1	4
Mechanical engineering	7	2	1	3	1	0	1	15
Metallurgical engineering	1	0	0	3	0	0	0	4
Mining engineering	0	0	0	2	0	0	0	2
Petroleum engineering	0	0	1	2	0	0	0	3
Welding engineering	0	0	0	1	0	0	0	1

VII. General Comments by Engineering Deans

THE LAST item on the questionnaire was an open-end question asking the deans of engineering for their "opinions on changes in curriculums or courses which will be needed in the future, and which have not been mentioned elsewhere in this survey."

Many helpful statements were received in response to this request, including comments on the study itself and ideas and opinions bearing on desirable future developments in engineering education. The more significant of these statements (eliminating duplications or near duplications) are abstracted below, and are numbered for easy reference:

1. Several changes in curriculums are contemplated for immediate future. Nature of laboratory courses to be changed and time allotted reduced. Surveying to be dropped for all except civil engineers. Materials, processes, and metallurgy courses to be radically revised and more time provided for study of science of materials. Coverage of physics to be increased. Continuing emphasis on "engineering" as opposed to "applied science." Engineering courses to become more scientific.

2. The questionnaire will not reveal many important changes since 1949, including:

> *Mathematics and basic science* have been upgraded in content so that with same number of required semester hours students reach much higher level of achievement. Mathematics faculty and facilities also improved. Content of basic science segment also has changed—introduction of chemistry of materials, "modern physics," shift in coverage from engineering to classical physics.
>
> *Humanities* category 10 years ago included much work of a professional-vocational nature. Now the category includes much more work of a strictly "humanities" nature.
>
> *Engineering sciences.*—"Here is where your survey will probably be most inaccurate." These courses have become much more truly fundamental, much less flavored by the professional disciplines.
>
> *Engineering analysis, design, and systems.*—"Design" courses of 10 years ago did not contain the coverage now believed to be important.
>
> *Electives or options.*—New curriculums differ radically from the former ones in opportunities and range of electives.
>
> *General.*—Engineering drawing has been reduced to a bare minimum; shop practice has disappeared; surveying has been greatly reduced; laboratory practice has been reduced; many new courses have been introduced to take care of technological advances. "Your survey will indicate the changes in the scientific content of curriculums, but it will not reveal what has happened to the engineering-technological-professional areas."

3. More attention must be given to graduate education, and professional engineers need more and more education beyond the bachelor's degree in order to get the training in creative design for which there is less and less room at the undergraduate level, and for which there is more and more need.

Control of graduate engineering education should be separated from general graduate faculty and vested in an autonomous engineering faculty. Also problem of maintaining quality.

4. There is a need to increase commonness among curriculums to maximum degree consistent with professional needs. This is feasible because contents of all curriculums are becoming more basic, thereby decreasing need for early professional deviation. Also desirable to make it possible for students to change departments during early years.

5. An integrated program of humanistic-social studies for all curriculums in 1960–61 is being planned, which will include credits for blocks (1) and (5). This portion will amount to approximately 21 percent of the curriculum.

Trend has been to increase number of credits required in each of the five blocks, thus increasing total course loads. This does not show up in percentages.

6. It is highly desirable to move in direction of 5-year programs. Thinks these are growing slowly in popularity even though engineering educators and industry presently favor the 4-year program.

7. A 2-year certificate program (essentially the first 2 years of general engineering) is being currently offered through the university extension, with 60 enrolled.

Likelihood of establishing a special program for gifted students in near future.

Although the percentages allocated to the five blocks of courses have not changed appreciably, the nature of practically all courses has changed materially. Basic and engineering sciences are being integrated and used in senior-year professional courses. Mathematics content has become more advanced.

8. This institution is moving rapidly toward a single engineering curriculum with about equal division of time between mathematics-basic sciences and engineering sciences, about 10 percent of time in analysis and design, and 20 percent in nontechnical electives. Will *not* require specific subjects in social sciences and humanities until these faculties offer liberal courses rather than courses designed to prepare scholars in those fields—but *will* encourage students to broaden their education by selective choices.

There will be less emphasis on preparation to earn a living and more on other educational purposes.

Graduate-level instruction will emphasize analysis and design, with undergraduate level concentrated on preparation for this.

9. No major changes have been made in percentage distributions among blocks of courses, but higher entrance requirements were established in 1958–59 in order to complete mathematics sequence earlier and add more physics.

10. While the engineering sciences trend has considerable merit, there is danger of letting the pendulum swing too far. Changes in curriculums should be made cautiously and gradually. Believe that in 10 or 15 years just one basic engineering degree will be required in all disciplines, and that specialization will occur at graduate level.

Considerably more effort should be focused on the better students, and not all of this in the engineering sciences direction. Still necessary to train professional engineers who can apply their talents to needs of industry.

11. The answers to part III are not very significant because of rearrangement of course materials. College algebra and trigonometry have been eliminated and replaced by courses in differential equations and atomic physics. Part of the material listed under engineering analysis in 1948–49 is now included under engineering sciences.

12. Requirements in engineering graphics have recently been reduced in some curriculums. "Shop" courses have changed from processing materials to acquiring understanding of fundamental properties, including atomic and molecular structures. In 1960 the first course in physics will be offered to second-semester freshmen, made possible by the unified mathematics series providing earlier introduction of calculus.

Possibilities for advanced placement in mathematics, chemistry, and English reduce time required to meet graduation requirements. Special programs for qualified students also available in mathematics, chemistry, and physics, providing deeper penetration, broader coverage, or completion in shorter time.

Six predictions are made for decade ahead:

Stiffening of entrance requirements.

Increased awards for precollege achievements.

Increased opportunities for faster rate of development for capable students.

More opportunities for study at advanced level.

Trend toward emphasis on blocks (1), (2), and (3).

Use of electronic computers in teaching and learning.

13. This institution is farther from a 5-year program now than it was in 1953. More and more students (30 percent last year) going on to graduate work.

14. The more significant changes do not show up in the percentages for question 3. Three examples:

(*a*) Mathematics and basic science courses at a more advanced level now.

(*b*) Analysis and design courses have come close to becoming engineering science.

(*c*) Approval of courses in humanistic-social area is more selective.

Although engineering has benefited from emphasis on the engineering sicences, the trend has two questionable effects: (1) An increasing percentage of capable students are moving all the way to sciences and mathematics to detriment of engineering enrollments; (2) some engineering curriculums are neglecting the very essence of engineering by neglecting practical, economic, and human factors.

Major revision of all curriculums, effective 1959–60, aims to maintain balance between science and art of engineering.

15. There will be continuing emphasis on engineering sciences during next 10 years. Extended engineering program also seems certain—either the 5-year program or some other arrangement. Tendency on part of many to think in terms of single engineering degree rather than separate classifications presently in use.

16. There is a temptation to include more science courses at expense of design and analysis courses. Think it important for students to become grounded in physical sciences, but equally important that they understand distinctive role of engineer.

Although the percentage distribution of courses among the five blocks has not changed materially, real changes have taken place in individual courses. More analytical and scientific methods employed. Routine classroom problems replaced by problems demanding more rigorous treatment. Empirical methods replaced by scientific ones.

Trend in future will be in same direction, but less pronounced now that technical-vocational courses have been eliminated. Content of individual courses still can be upgraded in keeping with scientific and engineering advances.

Another trend is increasing numbers of graduate students, particularly those following specialized programs to master's level. Creative engineers must have graduate work, which is essential if they are to work with the physicist and chemist. Ratio of graduate to undergraduate students has risen markedly, even with higher standards of admission to graduate school.

Appendix I

Basic Tables 1–6

Table 1.—"Old" curriculums: Number of curriculums and options offered during academic

[Condensed in

Curriculum or option	Region I East				Region II South				Region III South Central			
	A	B	C	D	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13
United States total	**243**	**135**	**31**	**25**	**180**	**94**	**19**	**22**	**95**	**36**	**24**	**16**
Total ECPD-recognized	**209**	**135**	**31**	**13**	**155**	**94**	**19**	**9**	**82**	**36**	**24**	**9**
Total "other"	**34**	**0**	**0**	**12**	**25**	**0**	**0**	**13**	**13**	**0**	**0**	**7**
ECPD-recognized												
Aeronautical	8	4	3	1	12	5	4	1	5	1	1	2
Agricultural	2	0	1	1	5	0	5	0	2	0	2	0
Architectural	1	1	0	0	6	2	0	3	5	1	1	2
Ceramic	3	1	1	0	4	3	1	0	-----	-----	-----	-----
Chemical	29	15	10	0	18	9	6	0	12	4	7	0
Civil	32	28	1	-----	26	21	0	-----	12	9	2	0
Electrical	36	29	1	-----	26	20	0	1	13	9	2	-----
Engineering Mechanics	1	0	0	-----	1	1	0	-----	1	0	0	0
Engineering Physics	4	1	2	1	4	0	0	-----	2	0	1	0
General Engineering	9	3	1	6	4	0	0	2	3	0	1	-----
Geological	2	0	2	0	2	0	0	0	3	0	2	1
Geophysical	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Industrial	11	4	2	1	9	3	3	1	3	1	2	0
Mechanical	36	29	1	0	24	20	0	0	12	8	2	1
Mettallurgical	11	6	4	-----	3	2	0	0	1	0	0	1
Mining	4	3	0	0	2	2	0	0	-----	-----	-----	-----
Naval Architecture and Marine	6	2	0	1	-----	-----	-----	-----	-----	-----	-----	-----
Petroleum	2	2	0	0	1	1	0	0	6	3	1	0
Sanitary	9	6	1	2	4	2	0	0	2	0	0	2
Textile	3	1	1	0	4	3	0	1	-----	-----	-----	-----
"Other"												
Administrative	6	0	0	2	1	0	0	1	-----	-----	-----	-----
Aeromechanical	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Air Conditioning, Heating and Refrigeration	-----	-----	-----	-----	2	0	0	1	1	0	0	1
Aircraft, Maintenance and Operation	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Application and Sales	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Applied Chemistry	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Applied Physics	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Basic Engineering	1	0	0	0	-----	-----	-----	-----	-----	-----	-----	-----
Biochemical	-----	-----	-----	-----	1	0	0	1	-----	-----	-----	-----
Building Construction	2	0	0	1	1	0	0	1	-----	-----	-----	-----
Business administration	-----	-----	-----	-----	1	0	0	1	1	0	0	0
Commercial	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Communications	4	0	0	3	3	0	0	1	-----	-----	-----	-----
Construction	-----	-----	-----	-----	2	0	0	0	-----	-----	-----	-----
Construction and Drainage	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Design	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Economic and Industrial	1	0	0	0	-----	-----	-----	-----	-----	-----	-----	-----
Electric Power	-----	-----	-----	-----	1	0	0	0	-----	-----	-----	-----
Electronics	2	0	0	2	2	0	0	2	1	0	0	1
Engineering Mathematics	1	0	0	0	1	0	0	0	-----	-----	-----	-----
Engineering Science	-----	-----	-----	-----	2	0	0	0	-----	-----	-----	-----
Fire Protection	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Furniture Manufacturing and Management	-----	-----	-----	-----	1	0	0	0	-----	-----	-----	-----
Glass Technology	1	0	0	0	-----	-----	-----	-----	-----	-----	-----	-----
Heat Power	-----	-----	-----	-----	1	0	0	1	-----	-----	-----	-----

See footnotes at end of table.

year 1949 in various categories; [1] by curriculum, by ECPD-recognized and "other"; by region

text table C]

Region IV Midwest				Region V Mountain				Region VI Pacific				Region VII Outlying				Total			
A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
290	**124**	**49**	**53**	**66**	**34**	**12**	**7**	**89**	**32**	**8**	**18**	**6**	**4**	**2**	**0**	**969**	**459**	**145**	**141**
241	**124**	**49**	**26**	**61**	**34**	**11**	**4**	**70**	**32**	**8**	**6**	**6**	**4**	**2**	**0**	**824**	**459**	**144**	**67**
49	**0**	**0**	**27**	**5**	**0**	**1**	**3**	**19**	**0**	**0**	**12**	**0**	**0**	**0**	**0**	**145**	**0**	**1**	**74**
22	6	5	7	4	1	0	1	5	2	1	1	0	0	0	0	56	19	14	13
10	2	6	0	2	0	1	0	3	0	2	0	0	0	0	0	24	2	17	1
6	4	0	1	4	1	1	1	3	1	0	1	0	0	0	0	25	10	2	8
4	4	0	0	-----	-----	-----	-----	1	1	0	0	-----	-----	-----	-----	12	9	2	0
26	13	8	1	6	2	2	-----	5	1	1	-----	-----	-----	-----	-----	96	44	34	1
32	22	4	1	9	7	2	-----	11	6	0	-----	2	1	1	0	124	94	10	1
33	23	4	-----	8	8	-----	-----	11	6	1	-----	1	0	1	-----	128	95	9	1
7	1	1	0	0	0	0	0	1	0	0	0	-----	-----	-----	-----	11	2	1	0
4	0	0	0	2	0	0	1	1	0	0	0	-----	-----	-----	-----	17	1	3	2
8	2	1	7	1	0	1	0	2	0	0	1	-----	-----	-----	-----	27	5	4	16
5	0	4	0	3	1	1	-----	1	0	0	1	1	1	0	0	17	2	9	2
1	0	1	0	1	0	1	0	1	0	0	0	-----	-----	-----	-----	3	0	2	0
13	3	5	2	1	0	1	0	4	1	2	1	-----	-----	-----	-----	41	12	15	5
34	22	5	-----	8	8	0	0	12	6	1	0	-----	-----	-----	-----	126	93	9	1
17	11	3	2	3	1	1	0	3	3	0	-----	1	1	0	0	39	24	8	3
9	7	0	1	4	3	0	0	3	3	0	0	1	1	0	0	23	19	0	1
1	1	0	-----	-----	-----	-----	-----	1	0	0	0	-----	-----	-----	-----	8	3	0	1
4	1	1	1	4	2	0	1	1	1	0	0	-----	-----	-----	-----	18	10	2	2
5	2	1	3	1	0	0	0	1	1	0	1	-----	-----	-----	-----	22	11	2	8
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	7	4	1	1
1	0	0	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	8	0	0	4
1	0	0	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	1
2	0	0	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5	0	0	3
-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	1	-----	-----	-----	-----	1	0	0	1
-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	1	-----	-----	-----	-----	1	0	0	1
-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	0	-----	-----	-----	-----	1	0	0	0
-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	1	-----	-----	-----	-----	1	0	0	1
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	0
1	0	0	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2	0	0	2
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3	0	0	2
-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	1	-----	-----	-----	-----	3	0	0	2
1	0	0	0	1	0	0	1	-----	-----	-----	-----	-----	-----	-----	-----	2	0	0	1
3	0	0	3	-----	-----	-----	-----	1	0	0	1	-----	-----	-----	-----	11	0	0	8
1	0	0	1	-----	-----	-----	-----	1	0	0	1	-----	-----	-----	-----	4	0	0	2
1	0	0	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	1
2	0	0	2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2	0	0	2
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	0
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	0
5	0	0	1	-----	-----	-----	-----	2	0	0	0	-----	-----	-----	-----	12	0	0	6
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2	0	0	0
1	0	0	0	-----	-----	-----	-----	1	0	0	0	-----	-----	-----	-----	4	0	0	0
1	0	0	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	0
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	0
1	0	0	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2	0	0	0
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	1

Table 1.—"Old" curriculums: Number of curriculums and options offered during academic year

Curriculum or option	Region I East				Region II South				Region III South Central			
	A	B	C	D	A	B	C	D	A	B	C	D
1	2	3	4	5	6	7	8	9	10	11	12	13
"Other"—Continued												
Highway Transportation	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	1
Highway	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Hydraulic	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	0
Industrial Management	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	0
Jet Propulsion	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Law and Engineering	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Machine Design	1	0	0	0	1	0	0	1	-----	-----	-----	-----
Maintenance	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Management	3	0	0	0	-----	-----	-----	-----	1	0	0	1
Mineral	2	0	0	0	-----	-----	-----	-----	-----	-----	-----	-----
Mineralogy	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Municipal	-----	-----	-----	-----	1	0	0	1	-----	-----	-----	-----
Natural Gas	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	0
Nuclear	-----	-----	-----	-----	1	0	0	0	-----	-----	-----	-----
Paper and Pulp	1	0	0	0	-----	-----	-----	-----	-----	-----	-----	-----
Petroleum Production	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Petroleum Refining	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	0
Physical Metallurgy	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Plastic	2	0	0	0	-----	-----	-----	-----	-----	-----	-----	-----
Power	3	0	0	3	3	0	0	2	2	0	0	2
Process	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Production	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	0
Radio	1	0	0	1	-----	-----	-----	-----	-----	-----	-----	-----
Railway	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Sanitary Science	1	0	0	0	-----	-----	-----	-----	-----	-----	-----	-----
Soil Conservation	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	1
Structural	2	0	0	0	-----	-----	-----	-----	-----	-----	-----	-----
Traffic	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Transportation	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Welding	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Categories:
A is number offered during academic year 1949.
B is number accredited during academic year 1949 or earlier.
C is number accredited after June 1949.
D is number discontinued since June 1949.

1949 in various categories; [1] by curriculum, by ECPD-recognized and "other"; by region—Continued

Region IV Midwest				Region V Mountain				Region VI Pacific				Region VII Outlying				Total			
A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	0	0	1
2	0	0	2	1	0	0	1	---	---	---	---	---	---	---	---	3	0	0	3
3	0	0	1	---	---	---	---	---	---	---	---	---	---	---	---	4	0	0	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	0	0	0
---	---	---	---	---	---	---	---	1	0	0	1	---	---	---	---	1	0	0	1
2	0	0	1	---	---	---	---	---	---	---	---	---	---	---	---	2	0	0	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2	0	0	1
---	---	---	---	---	---	---	---	1	0	0	1	---	---	---	---	1	0	0	1
1	0	0	0	---	---	---	---	---	---	---	---	---	---	---	---	5	0	0	1
---	---	---	---	---	---	---	---	1	0	0	1	---	---	---	---	3	0	0	1
1	0	0	0	---	---	---	---	---	---	---	---	---	---	---	---	1	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	0	0	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	0	0	0
1	0	0	0	---	---	---	---	---	---	---	---	---	---	---	---	2	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	0	0	0
1	0	0	1	---	---	---	---	---	---	---	---	---	---	---	---	1	0	0	1
---	---	---	---	1	0	0	0	---	---	---	---	---	---	---	---	2	0	0	0
---	---	---	---	---	---	---	---	1	0	0	0	---	---	---	---	1	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2	0	0	0
6	0	0	3	---	---	---	---	---	---	---	---	---	---	---	---	14	0	0	10
---	---	---	---	---	---	---	---	1	0	0	0	---	---	---	---	1	0	0	0
---	---	---	---	---	---	---	---	1	0	0	1	---	---	---	---	2	0	0	1
2	0	0	0	---	---	---	---	1	0	0	1	---	---	---	---	4	0	0	2
3	0	0	3	---	---	---	---	---	---	---	---	---	---	---	---	3	0	0	3
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1	0	0	1
4	0	0	2	1	0	0	1	---	---	---	---	---	---	---	---	7	0	0	3
1	0	0	1	---	---	---	---	1	0	0	1	---	---	---	---	2	0	0	2
1	0	0	1	---	---	---	---	1	0	0	0	---	---	---	---	2	0	0	1
---	---	---	---	1	0	1	0	---	---	---	---	---	---	---	---	1	0	1	0

Table 2.—"New" curriculums: Number of curriculums and options established since June

[Condensed in

Curriculum or option	Region I East			Region II South			Region III South Central		
	A	B	C	A	B	C	A	B	C
1	2	3	4	5	6	7	8	9	10
United States total	**63**	**10**	**1**	**38**	**3**	**0**	**27**	**10**	**4**
Total ECPD-recognized	**32**	**10**	**1**	**23**	**3**	**0**	**22**	**10**	**2**
Total "other"	**31**	**0**	**0**	**15**	**0**	**0**	**5**	**0**	**2**
ECPD-recognized									
Aeronautical	2	1	1	---	---	---	2	1	---
Agricultural	3	3	0	2	0	0	1	1	0
Architectural	---	---	---	2	0	0	1	0	0
Ceramic	---	---	---	1	0	0	---	---	---
Chemical	1	0	0	2	0	0	1	1	0
Civil	2	0	0	---	---	---	1	0	0
Electrical	6	0	0	3	0	0	1	1	0
Engineering Mechanics	5	3	0	3	1	0	---	---	---
Engineering Physics	1	0	0	1	0	0	---	---	---
General Engineering	1	0	0	---	---	---	---	---	---
Geological	---	---	---	---	---	---	2	1	1
Geophysical	---	---	---	---	---	---	---	---	---
Industrial	4	1	0	3	1	0	6	4	1
Mechanical	5	1	0	3	1	0	2	0	0
Metallurgical	1	1	0	2	0	0	1	0	0
Mining	---	---	---	---	---	---	---	---	---
Naval Architectural and Marine	---	---	---	1	0	0	---	---	---
Petroleum	---	---	---	---	---	---	4	1	0
Sanitary	---	---	---	---	---	---	---	---	---
Textile	1	0	0	---	---	---	---	---	---
"Other"									
Aeronautical Design	1	0	0	---	---	---	---	---	---
Aeronautical Science	---	---	---	---	---	---	---	---	---
Aeronautical Space	---	---	---	---	---	---	---	---	---
Aeronautical Technology	1	0	0	---	---	---	---	---	---
Air Conditioning, Heating, and Refrigeration	---	---	---	---	---	---	---	---	---
Air Hygiene	---	---	---	1	0	0	---	---	---
Air Weapons	---	---	---	---	---	---	---	---	---
Astronautics	---	---	---	---	---	---	---	---	---
Automotive	---	---	---	---	---	---	---	---	---
Business	---	---	---	---	---	---	---	---	---
Ceramic Science	1	0	0	---	---	---	---	---	---
Communications	---	---	---	1	0	0	---	---	---
Construction	---	---	---	1	0	0	1	0	1
Electronics	1	0	0	---	---	---	---	---	---
Engineering Management	2	0	0	---	---	---	---	---	---
Engineering Math	---	---	---	2	0	0	---	---	---
Engineering Science	6	0	0	2	0	0	---	---	---
Environmental	1	0	0	---	---	---	---	---	---
Flight Sciences	1	0	0	---	---	---	---	---	---
Food Engineering	---	---	---	---	---	---	---	---	---
Foundry	---	---	---	---	---	---	---	---	---
Gas Technology	---	---	---	---	---	---	---	---	---
Geodesy and Surveying	---	---	---	---	---	---	---	---	---
Guidance and Control	---	---	---	---	---	---	---	---	---
Hydraulics	---	---	---	---	---	---	---	---	---

See footnotes at end of table.

1949 in various categories; [1] by curriculum, by ECPD-recognized and "other"; by region

text table D]

Region IV Midwest			Region V Mountain			Region VI Pacific			Region VII Outlying			Total		
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
100	**10**	**22**	**17**	**1**	**2**	**41**	**6**	**0**	**5**	**0**	**0**	**291**	**40**	**29**
47	**10**	**6**	**10**	**1**	**1**	**26**	**6**	**0**	**4**	**0**	**0**	**164**	**40**	**10**
53	**0**	**16**	**7**	**0**	**1**	**15**	**0**	**0**	**1**	**0**	**0**	**127**	**0**	**19**
------	------	------	------	------	------	1	0	------	------	------	------	5	2	1
------	------	------	1	0	0	1	0	0	------	------	------	8	4	0
------	------	------	------	------	------	------	------	------	------	------	------	3	0	0
------	------	------	------	------	------	1	1	0	------	------	------	2	1	0
1	0	0	1	0	0	1	0	0	1	0	0	8	1	0
4	1	0	------	------	------	4	1	0	------	------	------	11	2	0
5	1	0	2	1	0	4	1	0	1	0	0	22	4	0
3	0	0	1	0	0	------	------	------	------	------	------	12	4	0
2	1	1	1	0	0	1	1	0	------	------	------	6	2	1
3	1	1	------	------	------	2	0	0	1	0	0	7	1	1
1	0	0	------	------	------	1	0	0	------	------	------	4	1	1
1	0	0	------	------	------	------	------	------	------	------	------	1	0	0
13	3	2	------	------	------	3	0	0	------	------	------	29	9	3
5	1	1	1	0	0	2	0	0	1	0	0	19	3	1
6	2	1	1	0	0	3	0	0	------	------	------	14	3	1
1	0	0	1	0	1	------	------	------	------	------	------	2	0	1
------	------	------	------	------	------	1	1	0	------	------	------	2	1	0
2	0	0	1	0	0	------	------	------	------	------	------	7	1	0
------	------	------	------	------	------	1	1	0	------	------	------	1	1	0
------	------	------	------	------	------	------	------	------	------	------	------	1	0	0
------	------	------	------	------	------	------	------	------	------	------	------	1	0	0
1	0	0	------	------	------	1	0	0	------	------	------	2	0	0
------	------	------	1	0	0	------	------	------	------	------	------	1	0	0
------	------	------	------	------	------	------	------	------	------	------	------	1	0	0
2	0	1	------	------	------	------	------	------	------	------	------	2	0	1
------	------	------	------	------	------	------	------	------	------	------	------	1	0	0
1	0	0	------	------	------	------	------	------	------	------	------	1	0	0
1	0	0	------	------	------	------	------	------	------	------	------	1	0	0
1	0	1	------	------	------	------	------	------	------	------	------	1	0	1
------	------	------	------	------	------	1	0	0	------	------	------	1	0	0
------	------	------	------	------	------	------	------	------	------	------	------	1	0	0
1	0	0	------	------	------	1	0	0	------	------	------	3	0	0
2	0	1	------	------	------	------	------	------	------	------	------	4	0	2
2	0	1	------	------	------	1	0	0	------	------	------	4	0	1
1	0	0	------	------	------	------	------	------	1	0	0	4	0	0
1	0	1	2	0	0	------	------	------	------	------	------	5	0	1
5	0	0	------	------	------	2	0	0	------	------	------	15	0	0
------	------	------	------	------	------	------	------	------	------	------	------	1	0	0
------	------	------	------	------	------	------	------	------	------	------	------	1	0	0
1	0	0	------	------	------	------	------	------	------	------	------	1	0	0
2	0	1	------	------	------	------	------	------	------	------	------	2	0	1
1	0	0	------	------	------	------	------	------	------	------	------	1	0	0
1	0	0	------	------	------	------	------	------	------	------	------	1	0	0
1	0	0	------	------	------	------	------	------	------	------	------	1	0	0
2	0	2	------	------	------	------	------	------	------	------	------	2	0	2

Table 2.—"New" curriculums: Number of curriculums and options established since June 1949

Curriculum or option	Region I East			Region II South			Region III South Central		
	A	B	C	A	B	C	A	B	C
1	2	3	4	5	6	7	8	9	10
"Other"—Continued									
Industrial Chemistry	1	0	0	------	------	------	------	------	------
Industrial Management	------	------	------	------	------	------	1	0	1
Instrumentation	------	------	------	------	------	------	------	------	------
Leather Technology	1	0	0	------	------	------	------	------	------
Management	3	0	0	------	------	------	------	------	------
Materials	1	0	0	------	------	------	------	------	------
Meteorological	------	------	------	------	------	------	------	------	------
Mineral	------	------	------	1	0	0	------	------	------
Municipal	------	------	------	------	------	------	------	------	------
Nuclear	7	0	0	6	0	0	2	0	0
Paper and Pulp	1	0	0	------	------	------	------	------	------
Planning	1	0	0	------	------	------	------	------	------
Plastic	1	0	0	------	------	------	------	------	------
Power	------	------	------	1	0	0	------	------	------
Refrigeration	------	------	------	------	------	------	------	------	------
Sales	------	------	------	------	------	------	------	------	------
Servomechanisms	------	------	------	------	------	------	------	------	------
Soils	------	------	------	------	------	------	------	------	------
Structures	------	------	------	------	------	------	------	------	------
Sugar	------	------	------	------	------	------	1	0	0
Surveying	------	------	------	------	------	------	------	------	------
Systems	1	0	0	------	------	------	------	------	------
Tool	------	------	------	------	------	------	------	------	------
Transportation	------	------	------	------	------	------	------	------	------
Welding	------	------	------	------	------	------	------	------	------

[1] Categories:
A is number established.
B is number accredited.
C is number discontinued.

in various categories; [1] by curriculum, by ECPD-recognized and "other"; by region—Continued

Region IV Midwest			Region V Mountain			Region VI Pacific			Region VII Outlying			Total		
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
------	------	------	------	------	------	------	------	------	------	------	------	1	0	0
------	------	------	------	------	------	1	0	0	------	------	------	2	0	1
2	0	0	------	------	------	------	------	------	------	------	------	2	0	0
------	------	------	------	------	------	------	------	------	------	------	------	1	0	0
2	0	1	------	------	------	------	------	------	------	------	------	5	0	1
1	0	0	------	------	------	------	------	------	------	------	------	2	0	0
1	0	0	------	------	------	------	------	------	------	------	------	1	0	3
------	------	------	------	------	------	1	0	0	------	------	------	2	0	0
1	0	0	------	------	------	------	------	------	------	------	------	1	0	0
10	0	0	2	0	0	5	0	0	------	------	------	32	0	0
------	------	------	------	------	------	------	------	------	------	------	------	1	0	0
------	------	------	------	------	------	------	------	------	------	------	------	1	0	0
------	------	------	------	------	------	------	------	------	------	------	------	1	0	0
2	0	1	------	------	------	------	------	------	------	------	------	3	0	1
1	0	1	------	------	------	------	------	------	------	------	------	1	0	1
------	------	------	------	------	------	2	0	0	------	------	------	2	0	0
1	0	1	------	------	------	------	------	------	------	------	------	1	0	1
2	0	1	------	------	------	------	------	------	------	------	------	2	0	1
2	0	1	------	------	------	------	------	------	------	------	------	2	0	1
------	------	------	------	------	------	------	------	------	------	------	------	1	0	0
1	0	1	------	------	------	------	------	------	------	------	------	1	0	1
------	------	------	------	------	------	------	------	------	------	------	------	1	0	0
------	------	------	1	0	0	------	------	------	------	------	------	1	0	0
1	0	1	------	------	------	------	------	------	------	------	------	1	0	1
------	------	------	1	0	1	------	------	------	------	------	------	1	0	1

Table 3.—"Old" curriculums: Number of degrees granted during academic years 1949 and 1959 and "other,"

[Condensed in

Curriculum or option	Region I East				Region II South				Region III South Central			
	Academic year 1949		Academic year 1959		Academic year 1949		Academic year 1959		Academic year 1949		Academic year 1959	
	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate
1	2	3	4	5	6	7	8	9	10	11	12	13
United States total	**10, 068**	**1, 627**	**7, 909**	**2, 676**	**5, 862**	**328**	**5, 604**	**486**	**3, 039**	**146**	**2, 281**	**269**
Total ECPD-recognized	**9, 286**	**1, 505**	**7, 677**	**2, 501**	**5, 561**	**324**	**5, 247**	**475**	**2, 868**	**140**	**2, 215**	**265**
Total "other"	**782**	**122**	**232**	**175**	**301**	**4**	**357**	**11**	**171**	**6**	**66**	**4**
ECPD-recognized												
Aeronautical	273	125	210	113	202	15	281	30	57	2	47	6
Agricultural	17	1	17	5	159	4	75	6	16	1	15	4
Architectural	28	1	6	0	82	1	31	2	28	0	38	0
Ceramic	49	11	78	10	33	6	65	5	---	---	---	---
Chemical	1, 138	272	848	299	456	87	435	71	355	28	242	41
Civil	1, 160	193	1, 037	300	935	31	928	46	507	46	304	50
Electrical	2, 535	367	2, 498	849	1, 341	87	1, 452	120	620	21	549	70
Engineering Mechanics	27	11	0	11	19	1	14	3	0	3	0	2
Engineering Physics	46	0	51	28	12	1	41	21	22	1	30	1
General Engineering	448	106	285	[illegible]	178	0	11	53	44	0	27	3
Geological	7	2	4	1	2	0	19	2	58	0	51	2
Geophysical	---	---	---	---	---	---	---	---	---	---	---	---
Industrial	376	56	165	61	423	13	410	22	61	3	71	16
Mechanical	2, 688	217	1, 943	475	1, 493	44	1, 413	65	877	29	596	50
Metallurgical	162	63	176	95	38	1	17	1	---	---	---	---
Mining	31	12	16	4	13	1	10	0	---	---	---	---
Naval Architectural and Marine	197	41	245	60	---	---	---	---	---	---	---	---
Petroleum	49	6	32	10	---	---	---	---	223	6	245	20
Sanitary	1	12	5	17	5	19	10	22	---	---	---	---
Textile	64	9	61	9	170	13	35	6	---	---	---	---
"Other"												
Admin. Engineering and Engineering Administration	555	100	99	56	---	---	---	---	---	---	---	---
Air Conditioning, Heating, and Refrigeration	---	---	---	---	23	0	16	0	---	---	---	---
Applied Chemistry	---	---	---	---	---	---	---	---	---	---	---	---
Applied Physics	---	---	---	---	---	---	---	---	---	---	---	---
Basic Engineering	22	0	15	0	---	---	---	---	---	---	---	---
Biochemical	---	---	---	---	---	---	---	---	---	---	---	---
Building Construction and Engineering	31	5	0	6	2	0	0	0	---	---	---	---
Business Engineering and Business Administration	---	---	---	---	---	---	---	---	1	0	2	0
Commercial	---	---	---	---	---	---	---	---	---	---	---	---
Communications	0	0	0	4	69	0	197	4	---	---	---	---
Construction	---	---	---	---	79	0	0	0	---	---	---	---
Economics, Industrial	19	1	16	13	---	---	---	---	---	---	---	---
Electric Power	---	---	---	---	77	0	35	0	---	---	---	---
Electronics	---	---	---	---	---	---	---	---	---	---	---	---
Engineering Mathematics	0	0	5	0	0	4	23		7---	---	---	---
Engineering Science	---	---	---	---	51	0	36	0	---	---	---	---
Fire Protection	---	---	---	---	---	---	---	---	---	---	---	---
Furniture Manufacturing and Management	---	---	---	---	0	0	15	0	---	---	---	---
Glass Technology	19	1	4	0	---	---	---	---	---	---	---	---
Hydraulic	---	---	---	---	---	---	---	---	0	6	0	0

in curriculums and options offered in academic year 1949; by curriculum, by ECPD-recognized by region

text table F]

Region IV Midwest				Region V Mountain				Region VI Pacific				Region VII Outlying				Total			
Academic year 1949		Academic year 1959		Academic year 1949		Academic year 1959		Academic year 1949		Academic year 1959		Academic year 1949		Academic year 1959		Academic year 1949		Academic year 1959	
B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
13, 590	**1, 306**	**10, 290**	**1, 585**	**1, 831**	**147**	**1, 579**	**147**	**1, 961**	**517**	**2, 044**	**663**	**37**	**1**	**89**	**3**	**36, 388**	**4, 072**	**29, 796**	**5, 829**
13, 262	**1, 262**	**9, 948**	**1, 570**	**1. 766**	**144**	**1, 568**	**141**	**1, 870**	**489**	**1, 923**	**640**	**37**	**1**	**89**	**3**	**34, 650**	**3, 865**	**28, 667**	**5, 595**
328	**44**	**342**	**15**	**65**	**3**	**11**	**6**	**91**	**28**	**121**	**23**	**0**	**0**	**0**	**0**	**1, 738**	**207**	**1, 129**	**234**
602	95	598	100	51	7	47	5	32	97	141	44	----	----	----	----	1, 217	341	1, 324	298
162	30	153	67	4	2	3	0	16	1	47	0	----	----	----	----	374	39	310	82
109	1	71	1	47	0	33	0	14	0	44	0	----	----	----	----	308	3	223	3
70	26	25	15	----	----	----	----	6	3	14	2	----	----	----	----	158	46	182	32
1, 375	243	911	214	118	20	96	10	76	33	52	19	----	----	----	----	3, 518	683	2, 584	654
1, 848	220	1, 422	342	360	44	306	22	409	97	298	126	31	0	79	0	5, 250	631	4, 374	886
3, 221	255	2, 814	349	394	19	421	54	529	135	568	256	0	0	3	0	8, 630	884	8, 305	1, 698
11	34	14	39	----	----	----	----	0	2	0	15	----	----	----	----	57	51	28	70
40	0	51	0	40	2	23	0	15	0	18	0	----	----	----	----	175	4	214	50
381	2	62	0	8	0	5	0	17	0	17	0	----	----	----	----	1, 076	108	407	210
29	2	47	1	91	13	67	6	5	0	0	0	3	0	0	0	195	17	188	12
1	2	12	3	28	1	21	1	0	0	1	5	----	----	----	----	29	3	34	9
549	17	282	40	36	0	11	0	145	1	80	23	----	----	----	----	1, 590	90	1, 019	162
4, 352	260	3, 102	289	375	22	340	24	551	107	569	127	----	----	----	----	10, 336	679	7, 963	1, 030
324	60	264	89	89	10	80	5	20	5	20	12	0	0	1	0	633	139	558	202
152	6	70	7	71	4	50	10	16	5	12	8	3	1	6	3	286	29	164	32
24	4	23	6	----	----	----	----	8	0	36	0	----	----	----	----	229	45	304	66
2	0	25	3	54	0	65	4	11	3	6	3	----	----	----	----	339	15	373	40
10	5	2	5	----	----	----	----	----	----	----	----	----	----	----	----	16	36	17	44
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	234	22	96	15
18	0	0	0	----	----	----	----	----	----	----	----	----	----	----	----	573	100	99	56
0	0	26	0	----	----	----	----	----	----	----	----	----	----	----	----	23	0	42	0
----	----	----	----	----	----	----	----	17	0	8	0	----	----	----	----	17	0	8	0
----	----	----	----	----	----	----	----	16	0	0	0	----	----	----	----	16	0	0	0
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	22	0	15	0
1	0	0	0	----	----	----	----	----	----	----	----	----	----	----	----	1	0	0	0
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	33	5	0	6
----	----	----	----	----	----	----	----	2	0	0	0	----	----	----	----	3	0	2	0
8	0	6	0	33	0	0	0	----	----	----	----	----	----	----	----	41	0	6	0
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	69	0	197	8
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	79	0	0	0
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	19	1	16	13
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	77	0	35	0
51	0	131	0	----	----	----	----	33	25	97	7	----	----	----	----	84	25	228	7
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0	4	28	7
6	0	4	0	----	----	----	----	5	3	5	2	----	----	----	----	62	3	45	2
13	0	11	0	----	----	----	----	----	----	----	----	----	----	----	----	13	0	11	0
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0	0	15	0
0	15	0	0	----	----	----	----	----	----	----	----	----	----	----	----	19	16	4	0
0	27	0	10	----	----	----	----	----	----	----	----	----	----	----	----	0	33	0	10

Table 3.—"Old" curriculums: Number of degrees granted during academic years 1949 and 1959 in by region—

Curriculum or option	Region I East				Region II South				Region III South Central			
	Academic year 1949		Academic year 1959		Academic year 1949		Academic year 1959		Academic year 1949		Academic year 1959	
	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate
1	2	3	4	5	6	7	8	9	10	11	12	13
"Other"—Continued												
Industrial Management	---	---	---	---	---	---	---	---	1	0	14	0
Law Engineering and Engineering Law	---	---	---	---	---	---	---	---	---	---	---	---
Mechanical Design	28	0	11	0	---	---	---	---	---	---	---	---
Management	101	7	72	67	---	---	---	---	94	0	0	0
Mineral Engineering	0	1	0	3	---	---	---	---	---	---	---	---
Mineral Exploration	---	---	---	---	---	---	---	---	---	---	---	---
Mineral Preparation and Engineering	1	0	3	9	---	---	---	---	---	---	---	---
Mineralogy	---	---	---	---	---	---	---	---	---	---	---	---
Natural Gas	---	---	---	---	---	---	---	---	1	0	1	0
Nuclear	---	---	---	---	0	0	35	0	---	---	---	---
Paper and Pulp	6	2	7	10	---	---	---	---	---	---	---	---
Petroleum Refining	---	---	---	---	---	---	---	---	14	0	6	0
Physical Metallurgy	---	---	---	---	---	---	---	---	---	---	---	---
Plastics	0	2	0	6	---	---	---	---	---	---	---	---
Power	---	---	---	---	---	---	---	---	---	---	---	---
Process	---	---	---	---	---	---	---	---	---	---	---	---
Production	---	---	---	---	---	---	---	---	60	0	43	4
Radio	---	---	---	---	---	---	---	---	---	---	---	---
Sanitary Science	0	3	0	1	---	---	---	---	---	---	---	---
Structural	---	---	---	---	---	---	---	---	---	---	---	---
Transportation	---	---	---	---	---	---	---	---	---	---	---	---
Welding	---	---	---	---	---	---	---	---	---	---	---	---

curriculums and options offered in academic year 1949; by curriculum, by ECPD-recognized and "other," Continued

Region IV Midwest				Region V Mountain				Region V Pacific				Region VII Outlying				Total			
Academic year 1949		Academic year 1959		Academic year 1949		Academic year 1959		Academic year 1949		Academic year 1959		Academic year 1949		Academic year 1959		Academic year 1949		Academic year 1959	
B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	1	0	14	0
2	0	0	0	------	------	------	------	------	------	------	------	------	------	------	------	2	0	0	0
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	28	0	11	0
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	195	7	72	67
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	0	1	0	3
------	------	------	------	------	------	------	------	9	0	0	0	------	------	------	------	9	0	0	0
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	1	0	3	9
0	2	0	2	------	------	------	------	------	------	------	------	------	------	------	------	0	2	0	2
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	1	0	1	0
0	0	0	3	------	------	------	------	------	------	------	------	------	------	------	------	0	0	35	3
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	6	2	7	10
------	------	------	------	32	3	11	6	------	------	------	------	------	------	------	------	46	3	17	6
------	------	------	------	------	------	------	------	2	0	6	0	------	------	------	------	2	0	6	0
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	0	2	0	6
14	0	19	0	------	------	------	------	------	------	------	------	------	------	------	------	14	0	19	0
------	------	------	------	------	------	------	------	7	0	5	1	------	------	------	------	7	0	5	1
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	60	0	43	4
189	0	139	0	------	------	------	------	------	------	------	------	------	------	------	------	189	0	139	0
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	0	3	0	1
21	0	0	0	------	------	------	------	------	------	------	------	------	------	------	------	21	0	0	0
2	0	0	0	------	------	------	------	0	0	0	13	------	------	------	------	2	0	0	13
3	0	6	0	------	------	------	------	------	------	------	------	------	------	------	------	3	0	6	0

Table 4.—"New" curriculums: Degrees conferred in first year degrees were granted and in academic and "other,"

[Condensed in

Curriculum or option	Region I East				Region II South				Region III South Central			
	First year		Academic year 1959		First year		Academic year 1959		First year		Academic year 1959	
	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate
1	2	3	4	5	6	7	8	9	10	11	12	13
United States total	**187**	**28**	**415**	**148**	**116**	**9**	**236**	**21**	**71**	**0**	**271**	**17**
Total ECPD-recognized	**117**	**5**	**290**	**63**	**38**	**8**	**149**	**14**	**70**	**0**	**270**	**15**
Total "other"	**70**	**23**	**125**	**85**	**78**	**1**	**87**	**7**	**1**	**0**	**1**	**2**
ECPD-recognized												
Aeronautical	5	0	35	4	----	----	----	----	9	0	55	8
Agricultural	2	0	21	16	3	0	1	0	1	0	15	2
Architectural	----	----	----	----	4	0	13	0	8	0	13	0
Ceramic	----	----	----	----	----	----	----	----	----	----	----	----
Chemical	----	----	----	----	0	0	9	0	11	0	17	0
Civil	4	0	4	0	----	----	----	----	2	0	10	0
Electrical	34	0	98	0	11	0	38	0	5	0	24	0
Engineering Mechanics	0	5	4	37	0	8	3	14	----	----	----	----
Engineering Physics	0	0	3	0	4	0	4	0	----	----	----	----
General Engineering	0	0	21	0	----	----	----	----	----	----	----	----
Geological	----	----	----	----	----	----	----	----	4	0	3	0
Geophysical	----	----	----	----	----	----	----	----	----	----	----	----
Industrial	54	0	35	0	9	0	31	0	20	0	81	4
Mechanical	2	0	53	0	6	0	43	0	4	0	32	0
Metallurgical	4	0	4	6	1	0	7	0	1	0	0	0
Mining	----	----	----	----	----	----	----	----	----	----	----	----
Naval Architectural and Marine	----	----	----	----	----	----	----	----	----	----	----	----
Petroleum	----	----	----	----	----	----	----	----	5	0	20	1
Sanitary	----	----	----	----	----	----	----	----	----	----	----	----
Textile	12	0	12	0	----	----	----	----	----	----	----	----
"Other"												
Aeronautical Science	----	----	----	----	----	----	----	----	----	----	----	----
Aeronautical Technology	1	0	1	0	----	----	----	----	----	----	----	----
Air Weapons	----	----	----	----	----	----	----	----	----	----	----	----
Business Engineering	----	----	----	----	----	----	----	----	----	----	----	----
Ceramic Science	0	2	0	1	----	----	----	----	----	----	----	----
Communications	----	----	----	----	----	----	----	----	----	----	----	----
Construction	----	----	----	----	6	0	27	0	----	----	----	----
Electronics	11	4	32	4	----	----	----	----	----	----	----	----
Engineering Management	20	0	31	0	----	----	----	----	----	----	----	----
Engineering Math	----	----	----	----	16	0	25	7	----	----	----	----
Engineering Science	19	0	23	1	----	----	----	----	----	----	----	----
Food	----	----	----	----	----	----	----	----	----	----	----	----
Guidance and Construction	----	----	----	----	----	----	----	----	----	----	----	----
Heating/Air Conditioning/Plumbing	----	----	----	----	----	----	----	----	----	----	----	----
Hydraulics	----	----	----	----	----	----	----	----	----	----	----	----
Industrial Chemistry	0	3	0	1	----	----	----	----	----	----	----	----
Instrumentation	----	----	----	----	----	----	----	----	----	----	----	----
Instrumentation Science	----	----	----	----	----	----	----	----	----	----	----	----
Leather Technology	3	1	7	1	----	----	----	----	----	----	----	----
Management	4	0	4	0	----	----	----	----	----	----	----	----

year 1959 in curriculums and options established since June 1949; by curriculum, by ECPD-recognized by region

text table G]

Region IV Midwest				Region V Mountain				Region VI Pacific				Region VII Outlying				Total			
First year		Academic year 1959		First year		Academic year 1959		First year		Academic year 1959		First year		Academic year 1959		First year		Academic year 1959	
B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
257	**45**	**610**	**220**	**23**	**1**	**74**	**17**	**162**	**32**	**337**	**89**	**5**	**0**	**15**	**0**	**821**	**115**	**1, 958**	**512**
197	**20**	**494**	**41**	**13**	**1**	**50**	**6**	**160**	**10**	**323**	**44**	**5**	**0**	**15**	**0**	**600**	**44**	**1, 591**	**183**
60	**25**	**116**	**179**	**10**	**0**	**24**	**11**	**2**	**22**	**14**	**45**	**0**	**0**	**0**	**0**	**221**	**71**	**367**	**329**
-----	-----	-----	-----	-----	-----	-----	-----	0	5	0	9	-----	-----	-----	-----	14	5	90	21
-----	-----	-----	-----	0	0	2	0	1	0	0	0	-----	-----	-----	-----	7	0	39	18
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	12	0	26	0
-----	-----	-----	-----	-----	-----	-----	-----	2	2	2	1	-----	-----	-----	-----	2	2	2	1
-----	-----	-----	-----	-----	-----	-----	-----	2	0	4	0	1	0	1	0	14	0	31	0
12	0	38	0	-----	-----	-----	-----	30	0	80	0	-----	-----	-----	-----	48	0	132	0
33	0	46	0	13	0	48	5	65	0	77	0	-----	-----	-----	-----	161	0	331	5
0	0	0	3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0	13	7	54
11	0	12	0	-----	-----	-----	-----	0	0	8	14	-----	-----	-----	-----	15	0	27	14
3	2	2	2	-----	-----	-----	-----	15	0	80	0	4	0	14	0	22	2	117	2
0	0	1	0	0	0	0	0	0	0	4	0	-----	-----	-----	-----	4	0	8	0
1	0	2	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	0	2	0
104	18	296	33	-----	-----	-----	-----	33	0	44	0	-----	-----	-----	-----	220	18	487	37
8	0	62	0	-----	-----	-----	-----	7	0	19	0	-----	-----	-----	-----	27	0	209	0
23	0	26	3	0	1	0	1	5	0	5	0	-----	-----	-----	-----	34	1	42	10
1	0	3	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	0	3	0
-----	-----	-----	-----	-----	-----	-----	-----	0	2	0	8	-----	-----	-----	-----	0	2	0	8
1	0	6	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	6	0	26	1
-----	-----	-----	-----	-----	-----	-----	-----	0	1	0	12	-----	-----	-----	-----	0	1	0	12
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	12	0	12	0
0	0	0	1	-----	-----	-----	-----	0	12	0	12	-----	-----	-----	-----	0	12	0	13
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	0	1	0
0	0	0	9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0	0	0	9
-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	0	-----	-----	-----	-----	1	0	0	0
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0	2	0	1
-----	-----	-----	-----	-----	-----	-----	-----	0	1	13	0	-----	-----	-----	-----	0	0	13	0
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	6	0	27	0
0	0	0	27	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	11	4	32	31
10	0	15	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	30	0	46	0
1	0	3	0	0	0	7	11	-----	-----	-----	-----	-----	-----	-----	-----	17	0	35	18
20	0	63	3	-----	-----	-----	-----	0	1	0	1	-----	-----	-----	-----	39	1	86	5
3	0	4	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3	0	4	0
0	0	0	11	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0	0	0	11
1	0	3	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	0	3	0
2	0	0	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2	0	0	0
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0	3	0	1
0	1	0	30	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0	1	0	30
0	1	0	4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0	1	0	4
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3	1	7	1
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	4	0	4	0

Table 4.—"New" curriculums: Degrees conferred in first year degrees were granted and in academic year "other," by region

Curriculum or option	Region I East				Region II South				Region III South Central			
	First year		Academic year 1959		First year		Academic year 1959		First year		Academic year 1959	
	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate
1	2	3	4	5	6	7	8	9	10	11	12	13
"Other"—Continued												
Management Science	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Materials	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meteorology	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Nuclear	0	9	0	69	56	1	35	0	0	0	0	2
Nuclear-Marine	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Nuclear Propulsion	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Nuclear Science	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Paper and Pulp	1	1	9	2	-----	-----	-----	-----	-----	-----	-----	-----
Planning	2	0	1	0	-----	-----	-----	-----	-----	-----	-----	-----
Plastics	9	0	17	0	-----	-----	-----	-----	-----	-----	-----	-----
Refrigeration	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Sales	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Sugar	-----	-----	-----	-----	-----	-----	-----	-----	1	0	1	0
Systems	0	3	0	6	-----	-----	-----	-----	-----	-----	-----	-----
Tool	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Welding	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

1959 in curriculums and options established since June 1949; by curriculum, by ECPD-recognized and —Continued

Region IV Midwest				Region V Mountain				Region VI Pacific				Region VII Outlying				Total			
First year		Academic year 1959		First year		Academic year 1959		First year		Academic year 1959		First year		Academic year 1959		First year		Academic year 1959	
B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S.	Graduate	B.S	Graduate
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
0	3	0	7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0	3	0	7
1	0	3	2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	0	3	2
0	2	0	4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0	2	0	4
14	16	25	76	-----	-----	-----	-----	0	3	0	27	-----	-----	-----	-----	70	29	60	174
0	0	0	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0	0	0	1
-----	-----	-----	-----	-----	-----	-----	-----	0	6	0	5	-----	-----	-----	-----	0	6	0	5
0	2	0	4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0	2	0	4
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	1	9	2
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2	0	1	0
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	9	0	17	0
8	0	0	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	8	0	0	0
-----	-----	-----	-----	-----	-----	-----	-----	1	0	1	0	-----	-----	-----	-----	1	0	1	0
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	0	1	0
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0	3	0	6
-----	-----	-----	-----	9	0	17	0	-----	-----	-----	-----	-----	-----	-----	-----	9	0	17	0
-----	-----	-----	-----	1	0	0	0	-----	-----	-----	-----	-----	-----	-----	-----	1	0	0	0

Table 5.—"Old" and "new" curriculums: Number of curriculums offered and degrees conferred in academic year 1959; by curriculum, by ECPD-recognized and "other"

[Condensed in text table H]

Curriculum or option	"Old" curriculums offered in AY 1949				"New" curriculums established since June 1949				Total			
	Number of curriculums	Number of degrees conferred			Number of curriculums	Number of degrees conferred			Number of curriculums	Number of degrees conferred		
		B.S.	M.S.	Ph. D.		B.S.	M.S.	Ph. D.		B.S.	M.S.	Ph. D.
1	2	3	4	5	6	7	8	9	10	11	12	13
United States total	**828**	**29, 796**	**5, 183**	**646**	**262**	**1, 958**	**470**	**42**	**1, 090**	**31, 754**	**5, 653**	**688**
Total ECPD-recognized	**757**	**28, 668**	**4, 963**	**629**	**154**	**1, 591**	**157**	**26**	**911**	**30, 259**	**5, 120**	**655**
Total "other"	**71**	**1, 128**	**220**	**17**	**108**	**367**	**313**	**16**	**179**	**1, 495**	**533**	**33**
ECPD-recognized												
Aeronautical	43	1, 324	267	31	4	90	19	2	47	1, 414	286	33
Agricultural	23	310	67	15	8	39	17	1	31	349	84	16
Architectural	17	223	3	0	3	26	0	0	20	249	3	0
Ceramic	12	182	26	6	2	2	1	0	14	184	27	6
Chemical	95	2, 584	515	139	8	31	0	0	103	2, 615	515	139
Civil	123	4, 374	822	64	11	132	0	0	134	4, 506	822	64
Electrical	127	8, 305	1, 523	172	22	331	5	0	149	8, 636	1, 528	172
Engineering Mechanics	11	28	49	21	12	7	38	16	23	35	87	37
Engineering Physics	15	214	35	15	5	27	14	0	20	241	49	15
General Engineering	11	407	209	1	5	117	2	0	16	524	211	1
Geological	15	188	12	0	3	8	0	0	18	196	12	0
Geophysical	3	34	8	1	1	2	0	0	4	36	8	1
Industrial	36	1, 019	155	7	27	487	34	3	63	1, 506	189	10
Mechanical	125	7, 964	934	96	18	209	0	0	143	8, 173	934	96
Metallurgical	36	558	149	53	13	42	7	3	49	600	156	56
Mining	22	164	30	2	1	3	0	0	23	167	30	2
Naval Architectural and Marine	7	304	66	0	2	0	7	1	9	304	73	1
Petroleum	16	373	39	1	7	26	1	0	23	399	40	1
Sanitary	14	17	39	5	1	0	12	0	15	17	51	5
Textile	6	96	15	0	1	12	0	0	7	108	15	0
"Other"												
Administrative	4	99	56	0	0	0	0	0	4	99	56	0
Aeronautical Science	0	0	0	0	2	0	11	2	2	0	11	2
Aeronautical Space	0	0	0	0	1	0	0	0	1	0	0	0
Aeronautical Technology	0	0	0	0	1	1	0	0	1	1	0	0
Air Conditioning, Heating, Refrigeration	2	42	0	0	1	3	0	0	3	45	0	0

Air Hygiene	0	0	0	0	1	0	0	0	1	0	0	0
Air Weapons	0	0	0	0	1	0	9	0	1	0	9	0
Applied Chemistry	1	8	0	0	0	0	0	0	1	8	0	0
Astronautics	0	0	0	0	1	0	0	0	1	0	0	0
Basic Engineering	1	15	0	0	0	0	0	0	1	15	0	0
Building Construction	1	0	6	0	0	0	0	0	1	0	6	0
Business Engineering	1	2	0	0	1	0	0	0	2	2	0	0
Ceramic Science	0	0	0	0	1	0	0	1	1	0	0	1
Commercial	1	6	0	0	0	0	0	0	1	6	0	0
Communications	3	197	8	0	3	13	0	0	6	210	8	0
Construction	2	0	0	0	2	27	0	0	4	27	0	0
Construction Drainage	(1)	0	0	0	0	0	0	0	(1)	0	0	0
Design	(1)	0	0	0	0	0	0	0	(1)	0	0	0
Economics and Industrial	1	16	1	12	0	0	0	0	1	16	1	12
Electric Power	1	35	0	0	0	0	0	0	1	35	0	0
Electronics	6	227	7	0	3	32	31	0	9	259	38	0
Engineering Management	0	0	0	0	4	46	0	0	4	46	0	0
Engineering Mathematics	2	28	7	0	4	35	18	0	6	63	25	0
Engineering Science	4	45	2	0	15	86	2	3	19	131	4	3
Environmental	0	0	0	0	1	0	0	0	1	0	0	0
Fire Protection	1	11	0	0	0	0	0	0	1	11	0	0
Flight Science	0	0	0	0	1	0	0	0	1	0	0	0
Food Engineering	0	0	0	0	1	4	0	0	1	4	0	0
Foundry	0	0	0	0	1	0	0	0	1	0	0	0
Furniture Manufacturing and Management	1	15	0	0	0	0	0	0	1	15	0	0
Gas Technology	0	0	0	0	1	0	0	0	1	0	0	0
Glass Technology	2	4	0	0	0	0	0	0	2	4	0	0
Geodesy and Surveying	0	0	0	0	1	0	0	0	1	0	0	0
Guidance and Control	0	0	0	0	1	0	11	0	1	0	11	0
Highways	(1)	0	0	0	0	0	0	0	(1)	0	0	0
Hydraulics	3	0	10	3	0	0	0	0	3	0	10	3
ndustrial Chemistry	0	0	0	0	1	0	1	0	1	0	1	0
Industrial Management	1	14	0	0	1	0	0	0	2	14	0	0
Instrumentation	0	0	0	0	2	0	34	0	2	0	34	0
Jet Propulsion	(1)	0	0	0	0	0	0	0	(1)	0	0	0
Law Engineering and Engineering Law	1	0	0	0	0	0	0	0	1	0	0	0
Leather Technology	0	0	0	0	1	7	1	0	1	7	1	0
Machine Design	1	11	0	0	0	0	0	0	1	11	0	0
Management	4	72	67	0	4	4	7	0	8	76	74	0
Materials	0	0	0	0	2	3	2	0	2	3	2	0
Meteorological	0	0	0	0	1	0	4	0	1	0	4	0
Mineral	2	3	10	2	2	0	0	0	4	3	10	2
Mineralogy	1	0	2	0	0	0	0	0	1	0	2	0
Municipal	0	0	0	0	1	0	0	0	1	0	0	0
Natural Gas	1	1	0	0	0	0	0	0	1	1	0	0

See footnote at end of table.

Table 5.—"Old" and "new" curriculums: Number of curriculums offered and degrees conferred in academic year 1959; by curriculum, by ECPD-recognized and "other"—Continued

[Condensed in text table H]

Curriculum or option	"Old" curriculums offered in AY 1949				"New" curriculums established since June 1949				Total			
	Number of curriculums	Number of degrees conferred			Number of curriculums	Number of degrees conferred			Number of curriculums	Number of degrees conferred		
		B.S.	M.S.	Ph. D.		B.S.	M.S.	Ph. D.		B.S.	M.S.	Ph. D.
1	2	3	4	5	6	7	8	9	10	11	12	13
"Other"—Continued												
Nuclear	2	35	3	0	33	60	174	10	35	95	177	10
Paper and Pulp	1	7	10	0	1	9	2	0	2	16	12	0
Petroleum Refining	2	17	6	0	0	0	0	0	2	17	6	0
Physical Metallurgy	1	6	0	0	0	0	0	0	1	6	0	0
Planning	0	0	0	0	1	1	0	0	1	1	0	0
Plastic	2	0	6	0	1	17	0	0	3	17	6	0
Power	4	19	0	0	2	0	0	0	6	19	0	0
Process	1	5	1	0	0	0	0	0	1	5	1	0
Production	1	43	4	0	0	0	0	0	1	43	4	0
Radio	2	139	0	0	0	0	0	0	2	139	0	0
Railway (Railroad)	(1)	0	0	0	0	0	0	0	(1)	0	0	0
Sales	0	0	0	0	2	1	0	0	2	1	0	0
Sanitary Science	1	0	1	0	0	0	0	0	1	0	1	0
Soils	0	0	0	0	1	0	0	0	1	0	0	0
Structural	4	0	0	0	1	0	0	0	5	0	0	0
Sugar	0	0	0	0	1	1	0	0	1	1	0	0
Systems	0	0	0	0	1	0	6	0	1	0	6	0
Tool	0	0	0	0	1	17	0	0	1	17	0	0
Traffic	(1)	0	0	0	0	0	0	0	(1)	0	0	0
Transportation	1	0	13	0	0	0	0	0	1	0	13	0
Welding	1	6	0	0	0	0	0	0	1	6	0	0

[1] Curriculum offered, but no degrees granted.

Table 6.—Differently named curricular fields: Number of curriculums offered and degrees conferred in academic years 1949 and 1959; by curriculum, by ECPD-recognized, by "other" named in academic year 1949, and by "other" named since June 1949

[Condensed in text tables E and I]

Categories of curriculums	Curriculums offered			Bachelors degrees conferred			Graduate degrees conferred		
	Academic Year 1949	Academic Year 1959	AY 1959 as percent of AY 1949	Academic Year 1949	Academic Year 1959	AY 1959 as percent of AY 1949	Academic Year 1949	Academic Year 1959	AY 1959 as percent of AY 1949
1	2	3	4	5	6	7	8	9	10
United States total	**969**	**1,090**	**113**	**36,388**	**31,755**	**87**	**4,072**	**6,341**	**156**
Total ECPD-recognized	**824**	**911**	**111**	**34,650**	**30,259**	**87**	**3,865**	**5,775**	**149**
Total "other" listed in academic year 1949	145	147	101	1,738	1,415	81	207	484	232
Total "other" listed since June 1949	-------	32	-------	-------	81	-------	-------	82	-------
Total "other"	**145**	**179**	**123**	**1,738**	**1,496**	**86**	**207**	**566**	**272**
ECPD-recognized									
Aeronautical	56	47	84	1,217	1,414	116	341	319	94
Agricultural	24	31	129	374	349	93	39	100	256
Architectural	25	20	80	308	249	81	3	3	100
Ceramic	12	14	117	158	184	116	46	33	72
Chemical	96	103	107	3,518	2,615	74	683	654	96
Civil	124	134	108	5,250	4,506	86	631	886	140
Electrical	128	149	116	8,630	8,636	100	884	1,700	192
Engineering Mechanics	11	23	209	57	35	61	51	124	243
Engineering Physics	17	20	118	175	241	138	4	64	1,600
General Engineering	27	16	59	1,076	524	49	108	212	196
Geological	17	18	106	195	196	100	17	12	71
Geophysical	3	4	133	29	36	124	3	9	300
Industrial	41	63	154	1,590	1,506	95	90	199	221
Mechanical	126	143	113	10,336	8,173	79	679	1,030	152
Metallurgical	39	49	126	633	600	95	139	212	153
Mining	23	23	100	286	167	58	29	32	110
Naval Architectural and Marine	8	9	112	229	304	133	45	74	164
Petroleum	18	23	128	339	399	118	15	41	273
Sanitary	22	15	68	16	17	106	36	56	156
Textile	7	7	100	234	108	46	22	15	68
"Other" listed in Academic Year 1949									
Administrative	8	4	50	573	99	17	100	56	56
Aeronautical Mechanics	1	Drop	-------	0	Drop	-------	0	Drop	-------
Air Conditioning, Heating, Refrigeration	5	3	60	23	45	196	0	0	-------
Aircraft Maintenance	1	Drop	-------	0	Drop	-------	0	Drop	-------
Application and Sales	1	Drop	-------	0	Drop	-------	0	Drop	-------
Applied Chemistry	1	1	100	17	8	47	0	0	-------
Applied Physics	1	Drop	-------	16	Drop	-------	0	Drop	-------
Basic Engineering	1	1	100	22	15	68	0	0	-------
Biochemistry	2	Drop	-------	1	Drop	-------	0	Drop	-------
Building Construction	3	1	33	33	0	0	5	6	120
Business Engineering	3	2	67	3	2	67	0	0	-------
Commercial	2	1	50	41	6	15	0	0	-------
Communications	11	6	55	69	210	304	0	8	(1)
Construction	4	4	100	79	27	34	0	0	-------
Construction and Drainage	1	Drop	-------	0	Drop	-------	0	Drop	-------
Design	2	Drop	-------	0	Drop	-------	0	Drop	-------
Economic and Industrial	1	1	100	19	16	84	1	13	1,300
Electrical Power	1	1	100	77	35	45	0	0	-------
Electronics	12	9	75	84	259	308	25	38	152
Engineering Mathematics	2	6	300	0	63	(1)	4	25	256
Engineering Science	4	19	475	62	131	211	3	7	233
Fire Protection	1	1	100	13	11	85	0	0	------
Furniture Manufacture	1	1	100	0	15	(1)	0	0	------
Glass Technology	2	2	100	19	4	21	16	0	0
Heat Power	1	Drop	-------	0	Drop	-------	0	Drop	-------

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[1] Mathematically infinite.

Table 6.—Differently named curricular fields: Number of curriculums offered and degrees conferred in academic years 1949 and 1959; by curriculum, by ECPD-recognized, by "other" named in academic year 1949, and by "other" named since June 1949—Continued

[Condensed in text tables E and I]

Categories of Curriculums	Curriculums offered			Bachelors degrees conferred			Graduate degrees conferred		
	Academic Year 1949	Academic Year 1959	AY 1959 as percent of AY 1949	Academic Year 1949	Academic Year 1959	AY 1959 as percent of AY 1949	Academic Year 1949	Academic Year 1959	AY 1959 as percent of AY 1949
1	2	3	4	5	6	7	8	9	10
"Other" listed in Academic Year 1949—Continued									
Highway Transportation	1	Drop	--------	0	Drop	--------	--------	Drop	--------
Highways	3	Drop	--------	0	Drop	0	0	Drop	--------
Hydraulics	4	3	75	6	0	0	33	13	39
Industrial Management	1	2	200	1	14	1, 400	0	0	--------
Jet Propulsion	1	Drop	100	0	Drop	--------	0	Drop	--------
Law and Engineering Law	2	1	50	2	0	0	0	0	--------
Machine Design	2	1	50	28	11	39	0	0	--------
Maintenance	1	Drop	--------	0	Drop	--------	0	Drop	--------
Management	5	8	160	195	76	39	7	74	1, 057
Mineral	3	4	133	10	3	30	1	12	1, 200
Mineralogy	1	1	100	0	0	0	2	2	100
Municipal	1	1	100	0	0	0	0	0	--------
Natural Gas	1	1	100	1	1	100	0	0	--------
Nuclear	2	34	1, 700	0	95	(1)	0	187	(1)
Paper and Pulp	1	2	200	6	16	267	2	12	600
Petroleum Production	1	Drop	--------	0	Drop	--------	0	Drop	--------
Petroleum Refining	2	2	100	46	17	37	3	6	200
Physical Metallurgy	1	1	100	2	6	300	0	0	--------
Plastics	2	3	150	0	17	(1)	2	6	300
Power	14	6	43	14	19	138	0	0	--------
Process	1	1	100	7	5	71	0	1	(1)
Production	2	1	50	60	43	72	0	4	(1)
Radio	4	2	50	189	139	74	0	0	--------
Railway	3	Drop	--------	0	Drop	0	0	Drop	--------
Sanitary Science	1	1	100	0	0	0	3	1	33
Soil Conservation	1	1	100	0	0	0	0	0	--------
Structural	7	5	71	21	0	0	0	0	--------
Traffic	2	1	50	0	0	0	0	0	--------
Transportation	2	1	50	2	0	0	0	13	(1)
Welding	1	1	100	3	6	200	0	0	--------
"Other" listed since June 1949									
Aeronautical Science	--------	2	--------	--------	0	--------	--------	13	--------
Aeronautical Space	--------	1	--------	--------	0	--------	--------	0	--------
Aeronautical Technology	--------	1	--------	--------	1	--------	--------	0	--------
Air Hygiene	--------	1	--------	--------	0	--------	--------	0	--------
Air Weapons	--------	1	--------	--------	0	--------	--------	9	--------
Astronautics	--------	1	--------	--------	0	--------	--------	0	--------
Ceramic Science	--------	1	--------	--------	0	--------	--------	1	--------
Engineering Management	--------	4	--------	--------	46	--------	--------	0	--------
Environmental	--------	1	--------	--------	0	--------	--------	0	--------
Flight Science	--------	1	--------	--------	0	--------	--------	0	--------
Food	--------	1	--------	--------	4	--------	--------	0	--------
Foundry	--------	1	--------	--------	0	--------	--------	0	--------
Gas Technology	--------	1	--------	--------	0	--------	--------	0	--------
Geodesy and Surveying	--------	1	--------	--------	0	--------	--------	0	--------
Guidance and Control	--------	1	--------	--------	0	--------	--------	11	--------
Industrial Chemistry	--------	1	--------	--------	0	--------	--------	1	--------
Instrumentation	--------	2	--------	--------	0	--------	--------	34	--------
Leather Technology	--------	1	--------	--------	7	--------	--------	1	--------
Materials	--------	2	--------	--------	3	--------	--------	2	--------
Meteorology	--------	1	--------	--------	0	--------	--------	4	--------
Planning	--------	1	--------	--------	1	--------	--------	0	--------
Sales	--------	2	--------	--------	1	--------	--------	0	--------
Sugar	--------	1	--------	--------	1	--------	--------	0	--------
Systems	--------	1	--------	--------	0	--------	--------	6	--------
Tool	--------	1	--------	--------	17	--------	--------	0	--------

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(1) Mathematically infinite.

Appendix II

Questionnaire

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
OFFICE OF EDUCATION
WASHINGTON 25, D.C.

To the Dean of Engineering:

The analysis of "other" engineering enrollments and degrees which was sent to you on July 18, 1958, furnishes indications as to some of the changes which have been made in recent years in the types of engineering curriculums offered in American colleges and universities, and points up the need for further information.

Many of these changes reflect the response of the engineering colleges to such developments as the industrial and military uses of nuclear energy, electronic controls and computers, the expanding use of plastics, the extension of automation, and the growing importance of inter-disciplinary studies (e.g., biochemistry, biophysics).

The response to the letter which accompanied the analysis indicates that the data requested in this questionnaire, when compiled nationally and regionally, will be of interest and value to engineering deans and teachers. Your cooperation, by filling out and returning the attached questionnaire promptly, will be greatly appreciated. A second copy is enclosed for your files and a mailing label for convenience in replying. You will be furnished a report of the study as soon as it is published.

Individual institutions will not be identified in the report. Instead, it is proposed to group institutions regionally, using the regions employed by the Engineering Manpower Commission and the Committee on Development of Engineering Faculties, which will facilitate comparison with reports of these groups, and in accordance with the levels of engineering degrees they have conferred since July 1, 1949, as reported in the annual surveys of engineering degrees conducted jointly by the Office of Education and the American Society for Engineering Education.

Cordially yours,

Henry H. Armsby
Chief for Engineering Education

Form RSH–72 (59)

Budget Bureau No. 51–5914
Approval Expires May 31, 1960

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Office of Education
Washington 25, D.C.

SURVEY OF TRENDS IN ENGINEERING EDUCATION: 1949 to 1959

When completed, this form should be returned to the Office of Education, Department of Health, Education, and Welfare, Washington 25, D.C., using the attached self-addressed label. No postage will be required.

Information supplied by: ______________________ (Date)______________

General Instructions

An effort has been made to make this form as nearly self-explanatory as possible, but the following points may be helpful.

Definitions

For the purpose of this study the following definitions will be considered as applying wherever the terms appear on the questionnaire.

Course.—An organized series of lectures or other forms of instruction, usually in a single subject (e.g., Reinforced Concrete Design).

Curriculum.—An organized program of courses leading to a degree (e.g., a 4-year program leading to a bachelor's degree in Civil Engineering).

Option.—A modification of a curriculum providing specialization in a subdivision of the general field of the curriculum, but leading to the same degree (e.g., Sanitary option of Civil Engineering, leading to a degree in Civil Engineering).

Filling All Blanks

Throughout the questionnaire, please write "No" or "None" where applicable. Blank spaces are ambiguous.

I. Curriculums and Options Which Were Offered in Academic Year 1948–49

(Please list all curriculums and options regardless of accreditation by the Engineers' Council for Professional Development (ECPD), and enter in col. 4 the year of initial accreditation of those which are now or have been accredited.)

Curriculum or option (Specify which)	Year established	Year first degree conferred	Year initially accredited by ECPD	Number of degrees conferred						If discontinued give year
				1948–49			1958–59			
				B.S.	M.S.	Ph. D.	B.S.	M.S.	Ph. D.	
(1)	(2)*	(3)*	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

*Please fill in columns (2) and (3) if data are readily available. Otherwise, enter NA (not available).
Use additional sheet(s) if necessary.

II. CURRICULUMS AND OPTIONS ESTABLISHED SINCE JUNE 1949

(Please list all curriculums and options regardless of accreditation by ECPD, and enter in col. 4 the year of initial accreditation of those which are now or have been accredited.)

Curriculum or option (Specify which)	Year established	Year first degree conferred	Year initially accredited by ECPD	Number of degrees conferred						If discontinued give year
				Year shown in column (3)			1958–59			
				B.S.	M.S.	Ph. D.	B.S.	M.S.	Ph. D.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

Use additional sheet(s) if necessary.

III. Important Revisions of Curriculums Since June 1949

In the table below the "Blocks of Courses" are those shown in the Report of the Committee on Evaluation of Engineering Education as published in the *Journal of Engineering Education*, issue of September 1955, page 45.

Please show in column 2 below the percentage distribution of time in your engineering curriculums for the academic year 1948–49, and in columns 3 to 6 similar distributions for subsequent years in which changes have been made up to the academic year 1958–59. Finally, in column 7 please show what the distribution will be by June 1961 if changes are planned during the next 2 academic years.

TIME DISTRIBUTION IN ENGINEERING CURRICULA

Block of Courses	Percentage of Time Assigned to Each Block					
	1948–49					1960–61
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Humanistic and Social Studies						
(2) Mathematics and Basic Sciences						
(3) Engineering Sciences						
(4) Engineering Analysis, Design and Systems						
(5) Options or Electives						

Do the figures above apply to all engineering curricula in your institution? Yes____ No____

If answer above is "No," please list here curricula to which they apply.

If significantly different figures apply to other curricula, or if more columns are needed to show changes, please report on a separate sheet (or sheets).

IV. Special Programs

A. *The "three-two" plan*

The "three-two" plan is defined as a formal arrangement between a nonengineering college and an engineering college, under which students attend the former institution for 3 years, taking a program agreed upon by the two institutions, and then attend the engineering college for 2 years. Satisfactory completion of the 5-year program leads to degrees from both institutions.

(Use additional sheet(s) if needed to answer the following questions.)

1. Does your institution have such a program in operation now? Yes ____ No ____

If yes—
  a. During what academic year did it start? ________
  b. Please list nonengineering colleges involved.
  c. How many students currently enrolled in engineering have completed the 3 years in a nonengineering college under this program?

If no—
  d. Is your institution planning to start this type of program within the next 2 academic years? Yes ____ No ____

2. If your institution does not have such a program in operation now, has it had one which has been discontinued? Yes____ No ____

If yes—
  a. During what academic year did it start? ________
  b. During what academic year was it discontinued? ________
  c. Why was it discontinued?

3. How many students have completed the 3–2 program in your institution and have received the two degrees? ____

B. *Five-year undergraduate engineering curriculums*

1. Please list undergraduate curriculums in your institution which normally required 5 academic years (170 or more semester hours or equivalent) for completion, and write "required" in column 3 if the 5-year program is required of *all* candidates for the B.S. degree in that curriculum, or "optional" if a 4-year curriculum is also offered.

DO NOT INCLUDE "THREE-TWO" OR COOPERATIVE PROGRAMS.

Curriculum	5-year program	
	Year first offered	Required or optional for B.S. degree
(1)	(2)	(3)

(Use additional sheet(s) if necessary.)

2. If it is definitely planned to change, within the next 1 or 2 academic years, any existing curriculums from 4-year to 5-year programs, please list the curriculums and outline the reasons for changing each. (Use additional sheet(s) if necessary.)

V. OPTIONAL ADDITIONAL INFORMATION

Opinions of deans of engineering are among the most important considerations in forecasting trends. If you have opinions on changes in curriculums or courses which will be needed in the future, and which have not been mentioned elsewhere in this survey, a statement of them (on an additional sheet) will be greatly appreciated.

○

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